THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 46. Thursday, February 18, 1932. No. 809.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of
THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2.
Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (5 lines).

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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

FEBRUARY 23.

Sheffield Metallurgical Association:—Ordinary meeting. "Material Requirements in Aircraft Structure, with Special Reference to Steel," Paper by H. J. Pollard.

Institute of British Foundrymen.

FEBRUARY 20.

Lancashire Branch (Junior Section):—Ordinary meeting at Manchester. "Some Observations on the Production of Light Iron Castings," Paper by F. Griffiths.

FEBRUARY 26.

London Branch (Junior Section):—Meeting in London. Open discussion on "Some Foundry Problems."

Middlesbrough Branch:—Ordinary meeting. "Some Practical Notes on Cupola Plant and Material Control," Paper by W. J. Calton.

FEBRUARY 27.

East Midlands Branch:—Ordinary meeting at Derby. "Methods of Producing Castings," Paper by E. Longden.

Wales and Monmouth Branch:—Ordinary meeting at Newport. "Foundry Sundries," Paper by J. J. McClelland.

Plasticity and Elasticity.

The behaviour of cast iron under high temperatures has directed attention to the nature of plasticity and elasticity. We use words in everyday speech like "toughness," "brittleness" and "hardness" without any very clear idea of what they actually mean, and most of us would be puzzled to define these terms if we were called upon to do so. Yet it is a common experience to find practical men say that pig-iron made a few generations ago was tougher than it is to-day, because it took a great deal more energy in using a sledge-hammer or a much bigger drop on to the ball to break it.

When we say that a thing is elastic we mean that it is able to return to its original shape after it has been pulled out of shape. A thing is plastic when, on being pulled out of shape, it takes the new shape and does not return to its original. Some materials, like bitumen, are capable of withstanding a certain amount of shock but will distort under pressure, and do not return to their original shape. A material such as wet sand or loam will stand a certain amount of pressure without yielding, but when it begins to yield it goes on yielding increasingly as the pressure increases. Even brittle materials like glass or sealing-wax will bend to some extent.

Cast iron is intermediate in character between the brittle materials and the truly elastic materials. If a bar of cast iron be put under a transverse test, for a small load there is quite an appreciable deflection and the deflection increases as the load increases; if, however, before the bar breaks, the load is removed, it will return almost to its original position, but not quite. The amount of deflection left when the load is removed is plastic deflection; in other words, the bar has changed its shape under load and has not returned to it. That part of the deflection not plastic is elastic, since it represents deflection which disappears when the load causing it is taken away. Very little experience with transverse testing suffices to show that the elastic deflection in cast iron is very much greater than the plastic deflection.

Another point of interest in this connection is that nearly all ordinary mechanical tests are taken in the cold. The question has often been asked whether cast iron is more brittle at very low temperatures, for example, in certain parts of the world where the temperature is more often below zero than above it, and has never been satisfactorily answered, although there is no reason to believe that the difference, if any, is considerable. A material, however, which is elastic at ordinary temperatures may soon become plastic if the temperature is raised, as is shown, for example, by ordinary cast steel, the mechanical properties of which begin to fall off at elevated temperatures earlier than with cast iron. Cast iron is more brittle in the cold but does not lose its elasticity or strength until a higher temperature is reached. There is also reason to believe that irons which by virtue of their composition are more brittle in the cold than even ordinary cast irons, are more rigid, *i.e.*, less plastic, at red heat.

Altogether the question of the elastic and plastic properties of materials deserve far more attention than they have hitherto received. It is rather remarkable that engineers in the past have so exclusively concentrated on the elastic properties of materials for the purposes of design when, for purposes of manufacture, that is, for rolling, extruding, tooling, etc., their plastic properties, their toughness and brittleness, etc., are equally important.

Basic Factors.

The recent editorials and correspondence dealing with various phases of costing in reference to cupola practice raises a number of questions which have interest as providing reliable figures for comparison rather than for use by the estimating department. One figure which strikes us as being worthy of collection and dissemination is the cost of materials and labour for patching cupolas, set out against the throughput of the furnace. We have privately ascertained a number of these, and the differences are almost unbelievable. One firm engages a regular Sunday shift specially to carry out major repairs, at a very considerable expenditure. Dr. Zirker has reported that in Germany they use 28 lbs. of patching per ton of throughput for small outputs and 14 lbs. for a 70-ton-a-day melt. These figures seem to be comparable with good but not the best British practice. We shall welcome further additions to our collection, which will be treated confidentially.

Another figure of equal interest is the total labour-hours utilised in collecting and transporting all the raw materials and charging them into the cupola, plus the cost of electricity or other motive power used, plus an allowance for the cost, depreciation and upkeep of any machinery used. In citing these figures we are not suggesting that they should be continuously embodied in any costing system, but for comparison with other people's figures, with the final object of making one definite move to effect a lasting improvement, if not finally to solve the problem. In some foundries the cost of lining and drying ladles and shanks is still chaotic. Harper's, in

(*Concluded on page* 112.)

XUM

Taking a View.

By A Metal Dealer.

In conversation with a business friend the other day, I asked him what view he was taking of the market outlook. "View," he ejaculated scornfully, "I don't take a view, I take a profit." The rejoinder set me thinking and reminded me that in these days taking a view is no easy matter, for who knows what fresh development may crop up only 24 hours ahead? Taking a profit sounds easy, but probably 80 per cent. of the losses made by speculators are due to the error of holding on too long in the hope of wringing the last penny out of the position. The man who makes it a standing rule to snatch a profit when it is available will no doubt on many occasions fail to realise all that he might have done, but just as certainly he will avoid the losses suffered by his greedier brethren.

It is, of course, obvious that unless it be the result of a chance shot, the fact that anyone is in a position to take a profit suggests that previously he must have "taken a view." Everybody has views about what is going to happen, and as far as operating on the market is concerned, it is just a question whether the view carries sufficient conviction to resolve itself into a transaction. Our views are, of course, influenced by what people are thinking and saying, and it is always difficult to know to what extent our own ideas have been worked upon and coloured by outside suggestions. The difficulty is to avoid the confusion due to many counsels, for in considering any proposition one finds that everyone looks at it from a different viewpoint. This suggests quite strongly that through all the welter of rumours and reports one's own opinion must prevail, and at the risk of doing the wrong thing, making your own decision must be paramount.

Many successful operators on the Metal Exchange work on the principle that the majority is always wrong, and by backing their fancy against the crowd they hold that success is reasonably assured. There is probably a good deal of truth in this, for the crowd sways the individual and mass thinking is only too often erroneous. Unquestionably the majority is always wrong right at the top of a rise or after a prolonged and severe fall, for the sentiment, be it favourable or adverse, which has carried the bull or the bear movement to its utmost limit, has lost all sense of proportion by that time and degenerated into a ramp of the worst kind. To take a correct view at such a time means setting one's opinion directly against what appears to be obviously correct, for prevailing sentiment is invariably supported by chapter and verse, giving what appears to be a gilt-edged reason why the turn has not yet come. "Nothing succeeds like success," says the old proverb, and it is certainly true that these bull and bear movements seem after a time to carry on of their own volition and to be capable of going on indefinitely. There is, however, another old saying which runs, "The unexpected always happens," and in taking a view it is just as well to bear this in mind, for it is certainly more than ever true to-day, and the operator for the rise may find the ground slipping from under his feet with startling rapidity. Undoubtedly events do occur unexpectedly which have immediate effect on the situation, and, since the change is not as a rule a lasting one, it behoves all those who are accustomed to take a view to sum up the new situation rapidly and act accordingly.

There are, of course, short views and long views, and obviously the former are the safer sort to follow. The long view of copper to-day may be correct at 12 cents, but the short view at 5 cents is probably more accurate from the aspect of successful speculation, the time factor being all-important.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

A Paper "Wangle."

To the Editor of The Foundry Trade Journal.

Sir,—I must entirely disagree with your correspondent, Mr. G. Moran, in his letter appearing in your issue of February 11, in which he states that my statement that Qualcast, Limited, cannot afford to buy scrap and jeopardise the quality of their product is a surprising one.

As one who has the interests of the foundry industry as a whole at heart, and whose products are sold on quality rather than price, I wish to make it perfectly clear that in my opinion Mr. Moran is seriously in error and will, if he is not careful, "wangle" himself into difficulties. In using only virgin pig as raw material one has a reasonable assurance, verified by one's own laboratory, that the raw material will be of a consistent specification throughout from each blast furnace. In purchasing scrap of any type one is absolutely in the dark. It is impossible to analyse mixed scrap satisfactorily, and mixed scrap might have been originally made in any one of the hundreds of foundries throughout this country who draw their raw materials from a further great variety of blast furnaces.

If anybody can show me how to cheapen our product I shall welcome him with open arms, but I am not prepared to run the risk of jeopardising quality for the sake of a few shillings a ton, and, when all is said and done, the foundry industry in the past has been held back because it has rather worked down to a price than up to an ideal. If every foundry in this country tackled the problems of its various customers from the point of view of saving them costs on the finished article after machining, rather than in trying to cut 3d. per cwt. off its price, we should not hear so much about castings being replaced with stampings and pressings as we hear to-day.—Yours, etc.,

V. Jobson,
Managing Director.

Qualcast, Limited,
Victory Road, Derby.
February 13, 1932.

To the Editor of The Foundry Trade Journal.

Sir,—I have carefully noted all Mr. Moran has to say in his letter published in your Journal last week, and I fail to see how the fact that he has given lectures makes my statement one for derision. That statement was based on the state of affairs as I have found, and still find, them in foundries when working at my profession of cupola fettler. I have fettled some scores of cupolas in Great Britain and on the Continent—Sweden, Denmark, Germany, etc., and having seen with my own eyes, I think I am in a position to voice an opinion, and I may say that up to the time of writing I have had no reason to change that opinion.

So far as the remarks contained in your article are concerned, I was not taking into account small items of expenditure such as the renewal of the wick and kerosene for the fettler's lamp, but had in mind large items only.—Yours, etc.,

T. H. Gray.

119, High Holborn,
London, W.C.1.
February 16, 1932.

Bessemer Gold Medal Award.—The Council of the Iron and Steel Institute have this year awarded the Bessemer Gold Medal to Prof. Henry Louis, M.A., D.Sc., in recognition of his distinguished work in the fields of mining and metallurgical science.

Random Shots.

One hears from foundry representatives so many humorous situations in which they have found themselves in the different foundries up and down the land that it is quite ecstatic to think of what happens when the salesman ventures forth in foreign lands. "Marksman" was fortunate enough, the other day, to hear the head of a well-known—one might almost say famous—foundry equipment firm recounting some of his quaint experiences in that happy hunting-ground of adventure (so the tourist agencies would have us believe), the Continent.

* * *

A particularly amusing incident occurred in Spain, that sorry remnant of a great empire. Mr. X (let me call him) was on the spot in a foundry, engaged on the ramming of a furnace lining. He knew no Spanish; the "interpreter" knew about five words of English—"interpreter," "good morning" and "good evening." Mr. X therefore resorted to pantomime and ciphers. He conveyed to the workmen by rehearsal that when he said "express" they were to ram with piston-like energy. And when he said "rosbif" they could revert to normal blows. I believe that he used two other casual expressions for different ways of ramming—"Christmas pudding" and "bank holiday" or something similar. The mental picture of languid Spaniards being startled into dynamic activity by the abracadabra of "bank holiday" seems to "Marksman" to be ludicrously funny.

* * *

The second-hand bookshop has its quiet fascinations, and "Marksman" has noted repeatedly with astonishment the great number of foundry and metallurgical text-books which can be bought for a song from the barrows and "bargain boxes." Fair warning to the student, however, is that these books are mostly antique first editions that have served their day and passed into the limbo of obsolescence. Text-books of any excellence on technical matters are invariably expensive, and having bought, the owner, it seems, tries to get his full money's worth by retaining a book until progress and discovery have rendered it either of little use or definitely misleading.

* * *

The Editor was telling me recently of a luxury carriage belonging to one of the great railway companies which has been fitted with sun-ray windows. My observation that the Underground, as the most enterprising of railway systems, ought to have adopted this type of glass long ago met with no enthusiastic comment. After all, why should it?

* * *

Apropos the discussion on cupola costing, I conversed some days ago with a proud foundry owner in the north. He was telling me things about his wonderful works organisation. "Do you know," he said, "that my costing system is the most perfect in the world? I know to one-tenth of a penny just what the least important job costs me!" Here he was interrupted. An office-boy's head was projected into the room.

"Please, sir, the broker's men have arrived."

Marksman.

Sandslinging Practice in the Foundry.*

By A. J. S. Shewan and R. Atchison.

This subject is approached with all the deference which is due from an engineer to the art of the foundryman, and will commence by giving a short description of the foundry in which a traction-type sandslinger operates and the nature of the work produced. The work handled is exceedingly general, and varies from small mass-production castings, 100 or 500 off, of a few pounds weight, dealt with in moulding machines in both green and dry sand, to the bulk of the work which is medium-sized castings, averaging from 10 cwts. to a ton, mostly in dry sand, formerly hand-rammed and now handled by the sandslinger. The biggest work of all, of course, is swept up in loam when the number off or the symmetry of the job lends itself more economically to this method, and castings of this type can be produced up to at least 40 tons weight. It is seen, therefore, that the small work is handled economically by the machines, and as regards the very large work there is no alternative to loam moulding, as castings of this type invariably comprise only one off at a time. The sandslinger, therefore, deals with the medium-sized castings, and these vary in general from, say, 5 cwts. to in extreme cases, say, 5 tons. This is fortunate to the extent that on this work there are usually a good number off to be cast, and, with a full pattern made, this suits the sandslinger admirably. At present there is an order for a steam cylinder and pump castings in quantities of 20 and 25 at a time, and this, taken with stock orders of 20 at a time for centrifugal pumps, which are too large for the moulding machines, will show that the work is well adapted for the sandslinger.

It is noteworthy that in certain cases the ramming time is so short after the mould has been prepared that the management has actually found it more economical, even in only moderate numbers off, to make two patterns so that the machine can be constantly employed on ramming. A case of this description occurred about six months ago, when the foundry had to cast four types of girders, 14 off each. Two of these types were identical, and in order to save time the patterns were duplicated so as to get them quickly through to the machine shop. These girders were afterwards machined 14 on a machine at one time, and the combined saving in the foundry and machine shop was appreciable. Obviously, if there was only one pattern, the planing machine would have been kept idle waiting for its full complement to machine and time would have been lost. This is an instance where it is an obvious duty not to consider the foundry alone, but in combination with the other production shops, so as to obtain the maximum of co-ordination.

The main point is, however, that the actual ramming time is nothing at all and that the difficulty is to get enough jobs to keep the sandslinger going. On an average there may be 20 or 25 different patterns being moulded at one time. These may vary from 1 off to 20 off, and in very busy times the duplication of patterns for quantities of 20 off or so is worth consideration, owing to the fact that the capacity of the machine is so enormous that the chief difficulty is to keep it employed all the time. The limitation of production is certainly not the capacity of the machine, but rather the available floor space for moulding. Given then a machine with such capacity, the next problem after the provision of patterns is that of moulding boxes and the same remarks that apply to the duplication of patterns apply to moulding boxes. As the capacity of the machine is so large the level of production has to be brought up by the provision of more and more boxes. As most of the work is hydraulic pressure work, and therefore dry-sand, the provision of an adequate supply of boxes is an important matter, bearing in mind that the average box is out of commission for at least three days after the moulding is finished, due to drying and casting. As far as possible the management keeps a standard range of sizes for boxes and ample are available, but in busy times the provision of the necessary boxes is a serious matter and the work must be kept as varied as possible, that is, using as many sizes of box as available in order that there may be sufficient of the one size always in commission for each job where the number off is considerable.

* A Paper read before the Lancashire Branch of the Institute of British Foundrymen. Mr. Roy Stubbs presiding.

Lay-out.

Dealing now with the question of foundry lay-out, it must be realised that the sandslinger is not a tool one can lay down without altering the rest of the foundry. The whole subject has to be carefully considered, and the subject dealt with the importance it deserves. Ample arrangements must be made for sand conditioning and feeding, and in this case with so much dry-sand work, the stoves have to be enlarged so that the boxes, as already discussed, shall not be out of commission for longer than necessary. This particular lay-out is as follows. The foundry comprises one single building about 700 ft. long. There is one main centre bay and two side bays. The whole is roughly divided into three parts, top, middle and bottom.

The top bay is the sandslinger-moulding bay and the machine itself operates on a standard-gauge railway track, running up the centre for the whole length of this division. At the very bottom of this division is located the sand-conditioning plant provided with an overhead hopper, whereby the reconditioned sand is filled into the machine 10 tons at a time.

The middle division is really the casting bay as the completed moulds are transferred from the top bay to be cast, in order to keep the top division clear for moulding. At the top of the middle division there is, as before mentioned, the sand-conditioning plant, in front of which the boxes are knocked out and the castings transferred to another bay for fettling. Both side bays of the middle division are occupied by moulding machines, one being medium and the other small. The most of one side bay in the middle division is taken up by the drying stoves. The bottom division is occupied on one side by the three cupolas and the remaining part of two bays are devoted to loam moulding and core-making. It will thus be seen that stoves, sand plant and number of boxes must be increased to cope with the sandslinger.

The Tractor Sandslinger.

This was installed about four years ago and the alterations to stoves and sand plant were carried out at the same time. The apparatus is mounted on two axles on a standard railway track. The hopper is filled from the sand plant and holds 10 tons. This is sufficient for about half an hour's continuous ramming, at the end of which time the machine is refilled from the overhead hopper which has become charged during the period of working, so that there is no delay. The speed of ramming is ½ ton per minute of sand, and the radius of the arm is 17 ft. 6 in. covering a width of 35 ft. The height of the head is about 8 ft. and the machine will ram into a pit at a depth of at least 9 ft. The machine is operated from the head by push buttons in conjunction with an automatic starter fixed on one end of the hopper. There are six compounded shunt motors on the machine as follow:—One 7½-h.p. for the impeller and final belt; one 15-b.h.p. for travel; one 7½-h.p for the sand-elevating buckets, the chain floor of the hopper and the riddle shaker; one 1-h.p. for the first sand belt; one 1-h.p. for the second sand belt, and one 1-h.p. for elevating the two outer arms. The automatic starter arranges for all operations in sequence, for instance, the belt capacities and speeds are arranged to receive from each other a definite amount of sand, which in turn is discharged at the proper moment into the single impeller at the head, which imparts to the sand the necessary kinetic energy for ramming. The bottom of the hopper consists of a chain-driven platform of plates lapping over each other, and running round sprockets at each end, the whole forming a continuous bottom. This platform discharges through a gate, the opening of which can be adjusted, to a jigging screen which separates any lumps of hard sand, which might otherwise pass to the head, and discharges these over the back of the screen into a shoot and away. The free sand passes through a screen and into the first bucket elevator, where it is picked up and discharged on to the first belt. The machine having three hinged arms, there are three belts, each receiving its supply by direct discharge from the preceding belt, until finally the sand is discharged in a stream into the propeller head, there to be scooped up and discharged by the single impeller. The speeds are arranged so that this scoop is bound to pick up, without any noticeable loss of sand, from the discharge from the belt.

The principal wearing points are:—(1) The impeller scoop, which is changed every day, being cast in the foundry in a permanent mould; (2) the rubbing plate which receives and directs the sand to the discharge, which is also made in the foundry from steel plate and lasts about four days; (3) the belts last several months and can be turned over if not too badly worn or damaged by sprigs, etc., and (4) the links and pins in the bucket elevator chain are bushed so these can be renewed fairly cheaply. The machine is operated by one labourer with a piecework bonus on the number of 10-ton loads rammed.

Moulding Operations.

Dealing now with the operations before and after ramming, the bottom half-pattern is laid on an ordinary moulding board or flat top, and the drag is placed round it. The facing sand is covered over the pattern and made firm by hand. Any pockets are sprigged and tucked tight. In the event of a screw having to be withdrawn for a boss, a spike is knocked into the boss to show its position, and allowance made for cutting down after ramming. The better arrangement is, of course, for loose pieces to be dovetailed into the main pattern. The drag should have a loose bottom-plate instead of stays. This is a much quicker process as one does not have to tuck the stays. The drag can now be rammed and care must be taken that the head of sandslinger is operated evenly all over the surface of the box so as to prevent soft places. Venting the mould is just as necessary with the sandslinger as it is when hand-rammed. The higher the head is from the mould the harder will be the ramming. The drag is now turned over by crane, after making the joint, on which grids are used in preference to gaggers. The latter arrangement gives more space for ramming. The top box is placed on and runner pegs put in position and tightened by tucking the sand round. The same procedure is now followed with the top half as regards the facing sand and loose parts. Riser pegs should have a nail protruding and be stuck into the pattern where required. After ramming up to the level of the top of the pattern, loose sand is removed and facing sand spread on and gaggers placed in position just as for hand-ramming. Long wood screws protrude through the box (top-half) to prevent the pattern falling out whilst being

turned over. The procedure after this is the same as if the mould were rammed by hand.

The moulder can have two or more jobs side by side, and whilst one is being rammed another is being prepared. For instance, the pattern for a centrifugal pump casing can be placed in a pit which has been prepared with a coke bed. The under-part of the pattern is rammed in the ordinary way by hand until the sandslinger can get at the job in a vertical direction. After the pit is rammed to the level of the joint of the pattern, the top-half box is put on and ramming takes place as usual by sandslinger.

To show the adaptation of the sandslinger, the following job is of interest. The job consists of a large centrifugal pump casing which would normally be swept out in loam in two halves, and the complete core made in the mould. No binders were required, as a space of 1 ft. was left round the brickwork and rammed hard by the sandslinger. The core was now built in the mould and thicknessed over to give the necessary thickness of metal. An ordinary top—large enough to cover the job—was used for the top half, this half being rammed by the sandslinger, so that the job was half swept up in loam and half rammed in sand. No pattern or corebox, therefore, was required, except the boards for the bottom half and the template for the top half of the core.

Speaking generally, the beauty of the machine is that, being all-electric, there is practically nothing to go wrong, and herein lies the superiority over a large jolting machine, with its compressed-air operation and crude, unmechanical movements, in addition to its non-portability.

The percentage saved on piecework prices between hand and machine ramming is generally about 20 per cent., but this varies considerably. Also it keeps the moulders on the more skilled operations and saves undue fatigue.

A quantity of work formerly made in loam and swept up is now done under the sandslinger with patterns. In connection with new standard designs of which the castings are too heavy and expensive to hold in stock in any number, the management always looks into the question of whether it is or is not worth while making a pattern. In computation, the full pattern charges are put against the sandslinger and the cost of boards and strickles against the loam method.

A Recent Case.

The firm received an order for a 36-in. centrifugal pump casing, two off, and the pump could have been moulded either in loam or under the sandslinger. Taking everything into consideration, it was found that with a two-off job sweeping up was cheaper, but if there had been three off, it would actually been cheaper to make a pattern and ram up under the sandslinger. This, of course, is an isolated instance and no definite rule could be laid down as to the number off at which it became more economical to use the sandslinger rather than sweep up, as this entirely depends on the relations of pattern charges to moulding charges, but it is sufficiently enlightening to prove that occasion can arise when it is actually cheaper to make a pattern for as small a number off as three. An additional advantage is that one can usually depend on a more accurate thickness of metal than if the job was swept up. This does not apply, of course, on a loam job where the core is made in the mould.

There are, however, certain disadvantages. It is very much easier to make an alteration or addition, such as flanges, feet, etc., on a loam job than it is on a pattern, and the charges for altering the pattern are much more expensive than the work entailed in putting an addition or alteration on a swept-up job. The biggest problem of all, however, is that of standard patterns and pattern storage. With constantly-changing designs, one has to be very careful as to whether the cost involved in making a full pattern will not be lost in a year or two, due to the change of design and the space required to store all these patterns becoming tremendous. Great considerations and forethought is necessary when deciding to alter a job formerly done in loam to a pattern under the sandslinger, and, in the author's opinion, unless the job will be an absolute standard, it is necessary that the cost of making the actual order in hand with a pattern should not exceed, unless by a very little, the cost of moulding in loam. This assumes, of course, that the job under consideration will come up again, when the fact of having the pattern available will certainly mean a much lower cost than sweeping up.

Catalogues Received.

Melting Furnaces. — British Reverberatory Furnaces, Limited, 88, Kingsway, London, W.C.2, have encased their new catalogue in a vivid red filing cover. This brochure is divided into four sections, the first of which acts as an introduction, and details the range of business undertaken. Their good standing with their customers is shown by the way in which the latter have collaborated by way of lending photomicrographs of typical material manufactured. The second section describes and illustrates the Sklenar Midget oil-fired tilting furnace. We have seldom seen the selling points of a furnace so logically and convincingly set out. The outlining of a day's work, from 8.20 a.m. to 6.10 p.m , giving every detail, is a particularly good piece of publicity, because of its patent honesty. It shows that during the day no less than 16 casts of 320 lbs. weight were made. The third section covers in a similar fashion the Sklenar Pigmy furnace, which holds 160 lbs. maximum of copper alloys or 60 lbs. of aluminium. The final section is devoted to coke-fired reverberatory furnaces. Whilst this form was the original Sklenar design, before oil-firing was adopted, it still has much to commend it. There is a school of thought that prefers coke as a fuel, owing to the absence of hydro-carbons in the combustible.

We understand that this brochure is available to our readers on request. We advise taking advantage of this offer and carefully preserving the catalogue as containing much specific data.

Fluxes.—A leaflet received from Messrs. Beecroft & Partners, Limited, Retort Works, Mappin Street, Sheffield, lists the prices they charge for a number of different fluxes, and gives detailed instructions as to how each one is to be used.

Basic Factors.

(*Concluded from page* 109.)

their new foundry at Willenhall, have deemed it worth while to install a special plant for this purpose; so have Kryn & Lahy and many others. Cost of ladles per ton of metal can be an appreciable amount if left to tradition and the mercies of the foundry labourer. The management, by the way, should personally take a lively interest in shanks, for rough treatment of the cheaper variety may result in fracture, with disastrous consequences. Oil or gas suggest themselves as good media for drying and heating shanks and ladles.

Mould- and core-drying costs should be related to weight of sand and boxes and temperature, against the cost of fuel used plus its handling. In other words, the thermal efficiency of the stoves should be calculated and considered in relation to the handling costs. The effectiveness of stoves could possibly be correlated by standardising an average water-evaporation figure per hour per unit surface. Our sympathies are with the foundry manager in his endeavour to work economically, as he possesses so few reliable figures with which he can compare his running costs.

Book Review.

Ryland's Directory, 21st Edition. Published by "The Iron and Coal Trades Review," 49, Wellington Street, London, W.C.2. Price £2 2s.

The field covered by this extraordinarily useful book is that of the coal, iron, steel, foundry, engineering, hardware and related trades and industries. The vast experience behind the production of this work which, by the way, contains more than 2,000 pages, enables the editors to provide a dual service to each section of the industries represented as buyers and sellers. Thus, if a firm of blast-furnace owners wishes to examine the potential sources of coke supply, or possible users of his products, he has in the same book complete reliable up-to-date lists. This example can be oriented to embrace the whole of the mining, engineering and metallurgical industries.

The system followed is first to give an intelligent list of the contents of the book and then a list of the towns and places. This is an extremely useful feature, for a representative can make sure in advance that he does not omit to call on a potential customer, as, on turning to the page dealing with that town in the geographical section, all the firms are listed by street number and district.

The next section lists and illustrates the trade marks of the industry. We know of cases where reference to this would have saved much time and trouble caused through selecting marks already covered.

The alphabetical section is of great magnitude, and has never been of such interest as the present time, because of the number of mergers that have taken place. These have been dealt with in a very commendable manner, and in the case of the more important mergers, histories of the participants are given.

Under each entry there is given an indication of the business of the concern, whilst the nature of its proprietorship, and in the case of large public companies, the capital, dividends and agencies are detailed. Brands and trade marks, too, are in many cases included.

The nature of the geographical section has already been indicated, and we need only amplify our criticism by indicating that the scheme followed is country, county, town (and where this last is large), street and number. This system has been also used in the larger classifications of the trade classified section, such as collieries, engineering works and foundries, but not for the specialities. In these numerous cases an alphabetical list is given, with the address indicated but not detailed, and reference is made to the general alphabetic section.

The next section has been designed to be of use to the technical side of the industry, as a detailed information is given of the products of the iron, steel and tinplate trades, such as sections turned out by the rolling mills, the type, analysis and brand of pig-iron smelted by the various furnaces and the like. The analyses of brands of pig-iron have been extended to include practically every make in the United Kingdom.

After a section which lists the exporters of iron, steel, tinplates and hardware, a very interesting section is devoted to the Dominions and foreign coal, iron, steel and foundry industries. It is interesting to note that lists of foundries in Australia, India, New Zealand and South Africa have been included.

We have taken a personal interest in the compilation of the list of British foundries, and have to acknowledge with sincere gratitude the help that has been so freely accorded to us by practically every supplier of foundry raw materials and requisites. As a result of this collaboration, it is the most complete and reliable list that could possibly be obtained.

XUM

Sand Testing in the Foundry.

By Wm. Y. Buchanan.

(*Continued from page* 100.)

On considering sand testing for the first time one naturally asks "What average density is used in the foundry and over what range are moulds rammed?" There is little use in developing sands of great strength at high densities if it is never used at or near these densities. The first attempt to find this range of densities was as follows:—A number of moulders were, each in turn, given an 800-c.c. brass cylinder to ram up and by weighing the apparatus the density of the sand core was obtained in each case. These were all done at the same time, using the same batch of sand. The variations shown in Table III are considerable when measured in terms of density. There is also, however, an intentioned variation in hardness in moulds as required by the nature of the casting to be produced. This method of finding the mould density is not very satisfactory for many reasons, and so a more convenient substitute was sought.

TABLE III.—*Comparison of Ramming of Various Moulders Making a Core of 800 c.cs. vol.*

Density.	Type of moulder.	Remarks.	Density.	Type of moulder.	Remarks.
1.600	Heavy green sand	—	1.385	Coremaker ..	Badly made.
1.600	,, ,,	—	1.535	Brass	—
1.710	,, ,,	Wet	1.410	,, ...	—
1.580	,, ,,	Dry	1.490	,, ...	—
1.630	,, ,,	—	1.580	,, ...	—
1.475	,, ,,	—	1.465	,, ...	—
1.600	,, ,,	—	1.520	,, ...	—
1.540	,, ,,	With great care	1.480	Light green sand	—
1.500	,, ,,	—	1.455	,, ,,	—
1.575	,, ,,	—	1.625	,, ,,	—
1.550	,, ,,	Good	1.690	,, ,,	Very hard ramming
1.600	,, ,,	—	1.425	,, ,,	—

Average density, 1.550.

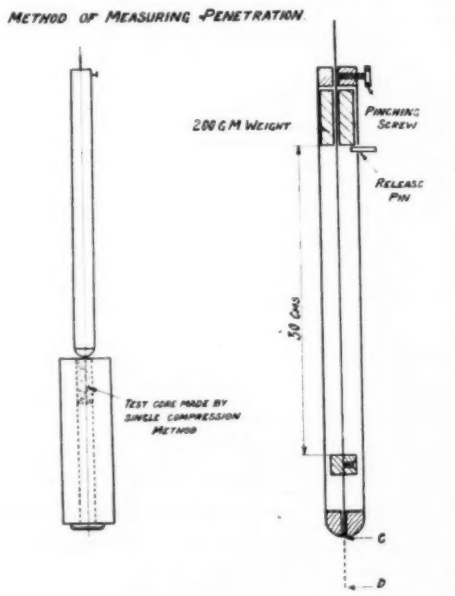


FIG. 15.—APPARATUS FOR DETERMINING THE RAMMING DENSITY OF A MOULD BY WIRE PENETRATION.

The degree of ramming of the sand was measured by its resistance to penetration of a steel wire under a definite blow. Penetration in millimetres when plotted against density was found to give a straight line over the usual range of densities (Table IV).

The most convenient form of this apparatus is shown in Fig. 15, the steel wire and falling weight being enclosed in a tube which acts as a guide for the wire. To calibrate the apparatus a test core is made by single-compression method, the mould turned upside. Having drawn the wire back till it is just flush with nose of tester (*c*) the apparatus is allowed to rest on the centre of the core with the wire quite free, and by releasing the weight the penetration is made. After clamping the wire in its new position the tester is removed from the core and the distance C.D., *i.e.*, the amount of pentration, measured. Cores of various densities, for example, 55 gms., 59 gms., 61 gms., 63 gms., tested in this way give a straight-line graph. The mould made of similar sand is tested for penetration and using a graph or a table of densities and penetrations, made from it, the mould density is read off.

If the test sand used to produce this graph is normal in moisture content and quality a very good idea of the average density will soon be got as the actual test on the mould takes a few seconds.

TABLE IV.—*Comparison of Ramming of Various Moulders, using Penetration Method.*

Density.	Green sand. Type of job.	Density.	Dry sand. Type of job.
1.640	Plumber block cover.	1.720	Coupling.
1.575		1.660	
1.555		1.740	
1.558	Coupling.	1.710	Discharge box.
1.562		1.640	
1.544	Wedge block.	1.670	
1.572		1.720	
1.588		1.750	
1.588	Pump body.	1.740	Large shell.
1.526	Pump body.	1.660	
1.528	Oil ring.	1.650	
1.560	Pipe branch.	1.750	
1.560	Slide rail.	1.740	
1.440	Bedplate.		
1.480			
1.490	Hopper.		
1.490	Shell segment.		
Average density, 1.544.		Average density, 1.71.	

Table IV shows the type of results obtained. The average for green sand agreed with that obtained by the previous method 1.544 against 1.550. The variation in the same mould is shown clearly by this test and problems raising the question of hardness of ramming in specific parts of moulds could be investigated in this way. A neat round hole ¼ in. dia. is made in the mould face and this might quite well be left unrepaired.

A separate calibration graph is required for each type of sand, *i.e.*, dry sand, core sand, oil sand, and the time required to make the graph is 10 to 15 min. Reversing the core during compression is not necessary to ensure accurate results, because the softness of the lower end of the core when it does exist is mostly round the edges while the penetration takes place down the centre. A test done on dry sand which as stated earlier is most liable to softness at the lower end in single-compression cores shows here 1½ mm. difference at most.

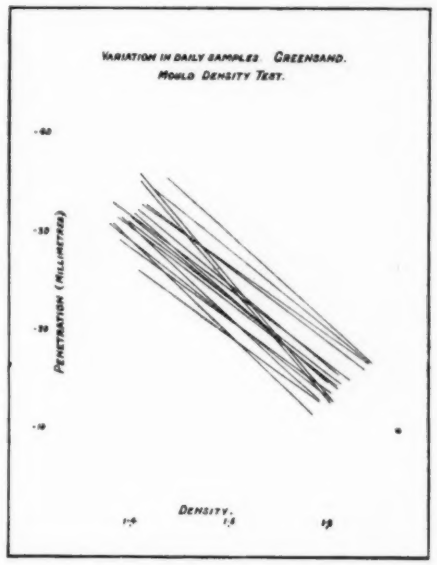


FIG. 16.—DAILY VARIATION TESTS MADE BY THE PENETRATION METHOD.

The provision of several weights, say 300 gms. 200 gms. and 100 gms., is useful, as for example in the case of oil sand a very light weight is necessary. It is, of course, best to use the heaviest weight which will suit the type of sand to be treated in order that the reading may be as large as possible. There appears to be a direct relationship between the weight used and the penetration. As the densities used in this test are apparent densities the method is subject to moisture effect already described.

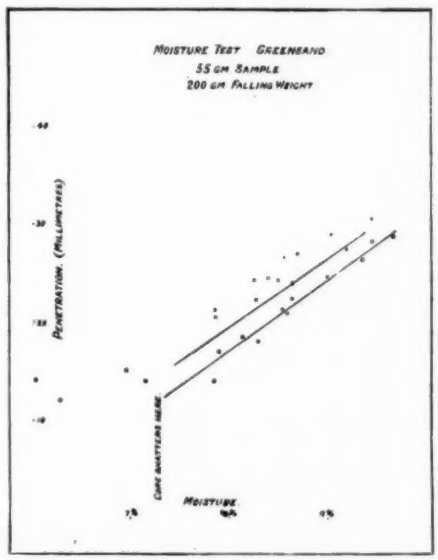


FIG. 17.—SHOWING THE USE OF PENETRATION APPARATUS AS A MOISTURE METER.

A number of these calibration graphs in Fig. 16 show the variation which was noted in daily

samples over a period. This variation suggests a method of determining moisture referred to later. If the milled sand is controlled by some type of "moisture meter" or other device this difference will not exist, but tests will be perfectly accurate if made on moulds made from the same sand as that used for calibration.

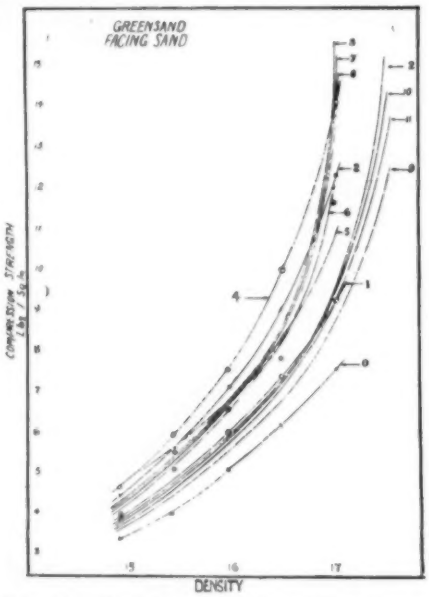


Fig. 18.—Effect of New Sand Additions on Strength of Facing Sand.

In order to use the density testing apparatus as a moisture meter advantage is taken of the difference between degree of ramming and apparent density. The procedure is the same as in making a calibration graph except that one density only is used and the moisture is varied by drying the sand in stages. The moisture by evaporation, and penetration test at the agreed density, are carried out at each stage in drying. The lower line in the graph Fig. 17 gives the moisture by this method and the points represented by circles give the results by evaporation method. The agreement in a single sample is therefore very good. Taking samples at random from the mill, the graph was moved upwards to the second position and the points represented by crosses indicate these results. The error is higher, due to the influence of the many factors which come into play in the foundry. Thus if sand is produced having a penetration value of 24, the variation of moisture should not exceed 0.7 per cent.—*i.e.*, 8.3 to 9 per cent. The accuracy to be expected in dry sand appears to be much the same. It appears that the actual bond strength of the sand does not affect the penetration value.

For daily moisture control the sand mixtures would be made to have a specified penetration value, a higher value would indicate too much moisture and a lower value the opposite. If the sand is put into bins in horizontal layers and removed by cutting vertically as in the previous sand practice the moisture variation will be reduced accordingly.

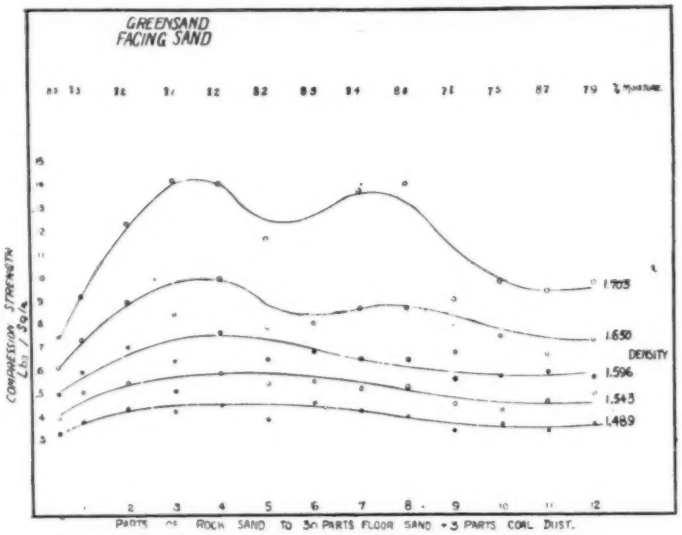


Fig. 19.—Showing how Relatively Small Additions of New Sand are Effective.

Effect of Variation of New Sand.

The object in view when starting out to investigate the effect of additions of new rock sand to facing sand was to draw up a table giving the properties of each mixture and to express these briefly, as, for example, 6-35 sand or 7-40 sand, when the first figure would give the compression strength at the average moulding density and the second figure the permeability at the same density and 10 cm. gas pressure. The idea was to use these special sand mixtures for specific types of jobs. In the graphs (Fig. 18) for variation of rock sand, note the regular shape of the curves made by single-compression method as compared with results previously obtained by hand-rammed cores.

The same results represented in a different manner indicate that at or near 1.55 density (the average foundry moulding practice) the greatest strength is reached at 4 parts rock sand to 30 parts floor sand. Thus the high rock sand additions erroneously used to give great strength in the facing sand, some of which were at least 12 parts rock sand, are not only wasteful but actually reduce the strength to that obtainable with 1 part rock sand to 30 parts floor sand. This is shown in Fig. 19.

The permeability curves were also plotted from tests got by hand ramming as described in the B.C.I.R.A. directions and from these curves the two curves shown in Fig. 20 were constructed. The sand is least permeable at 4 parts rock sand

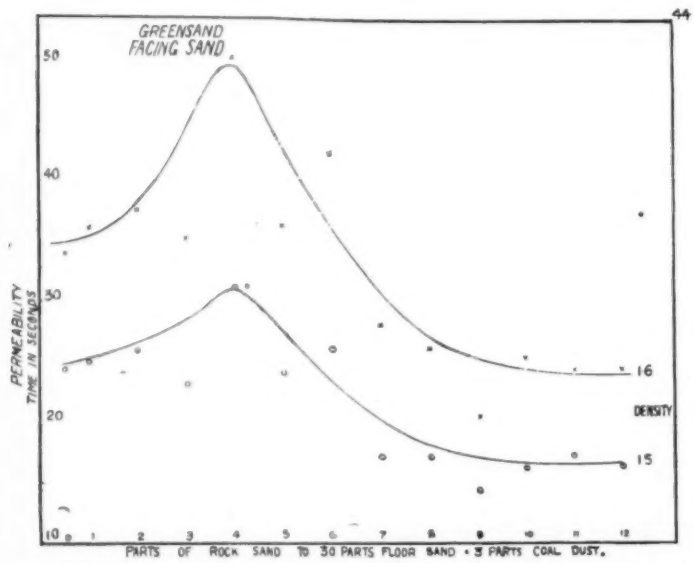


Fig. 20.—Permeability is at a Maximum with Modest Additions of New Sand.

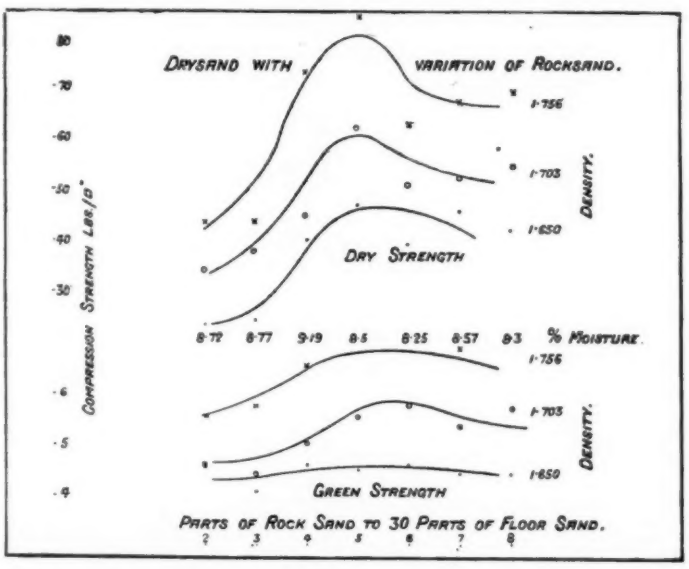


Fig. 21.—Showing Strength Decreasing with the Higher Additions of New Sand.

and then becomes more permeable with high additions of rock sand. Testing dry sand showed that the maximum strength was obtained at 4 parts rock sand in the green state and similarly in the dry state.

These graphs can be plotted directly without first making a curve for each sample tested, as is required with hand-rammed tests, and this shortens the time required.

A repeat set of tests strengthens this conclusion regarding rock sand addition. If rock sand, as received, is tested for compression strength and permeability it will be found to have low strength and high permeability, and thus when present in excess it tends to impart these properties to the facing sand (Fig. 21).

Moisture Variation on Dry Sand.

A number of daily samples tested at 1.7 density indicate that at moisture range usually found green strength is not affected, but that dry strength is decidedly higher at the high-moisture content (Fig. 22). The question of time required in drying would, of course, be kept in view when deciding on what moisture content to use in the foundry.

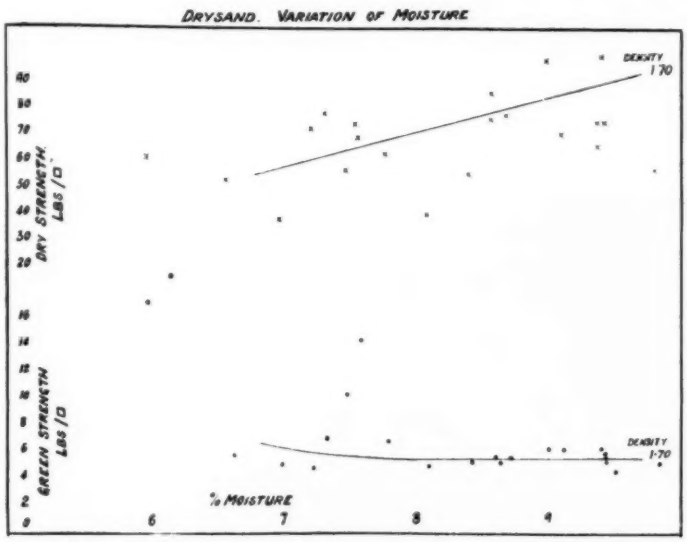


Fig. 22.—Showing the Strength of Dry Sand is Higher with Increasing Moisture.

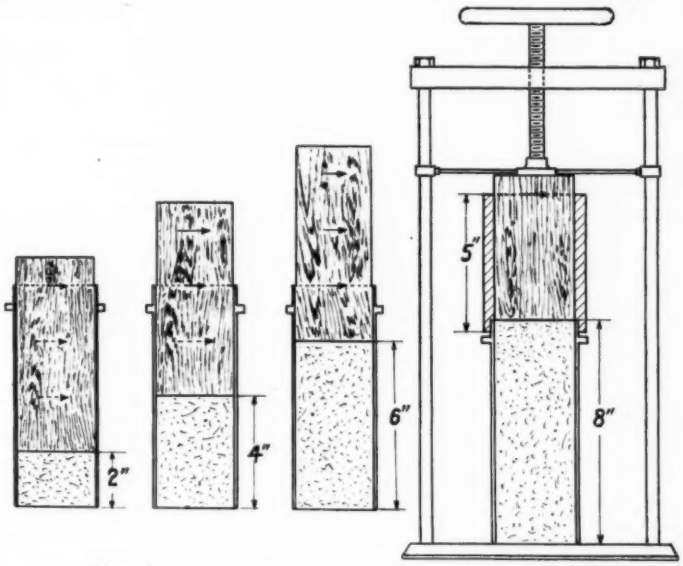


Fig. 23.—Showing the Ramming of Permeability Test Cores by Stages.

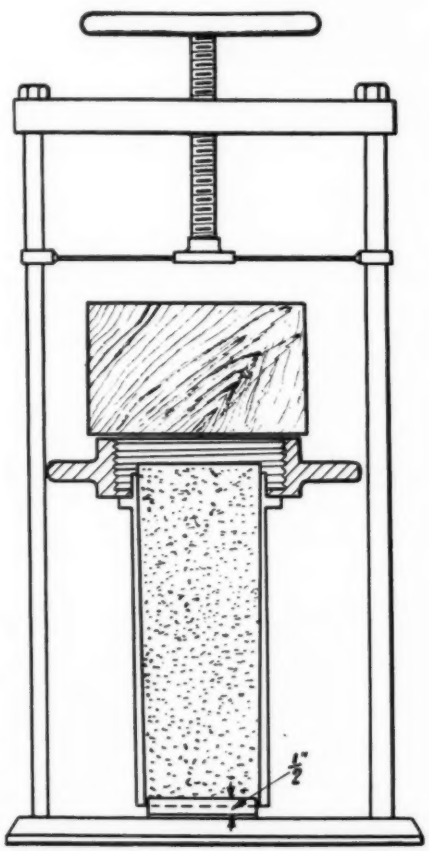


Fig. 24.—Showing Method of Removing Permeability Core for Drying.

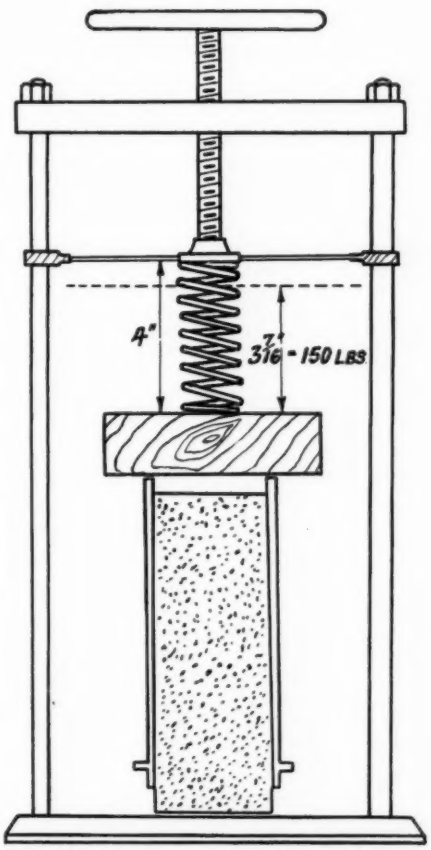


Fig. 25.—Showing how the Dried Core is Replaced in the Brass Cylinder for the Permeability Test.

Permeability Test.

The B.C.I.R.A. method for permeability is again hand ramming, but in this case, since the test-piece is very much larger, there is not the same difficulty, and rammers of various weights were used quite successfully in this case. However, for daily tests this means making a graph for each sample, and requires a large sample of sand. As in the case of the strength test, a compression method was applied. Fig. 23 shows

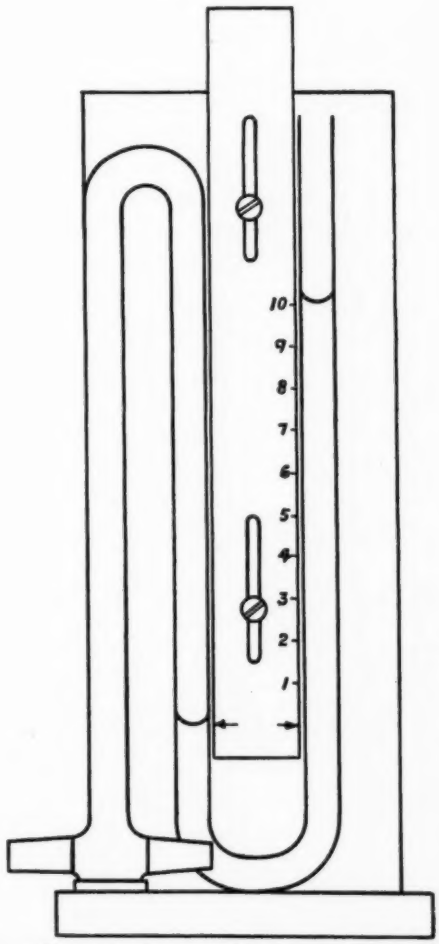


Fig. 26.—Type of Manometer Used.

the method. It was obvious that ramming all at once was quite unsuitable, and so it was decided to do so in several stages, as shown. The weight of sand corresponding with the required density was divided into four equal parts. These were transferred to the cylinder and compressed one at a time, using a marked plug and the testing machine frame to complete the pressure. To catch the loose fourth lot of sand, an extension was slipped over the end of the cylinder, and a plug again used to produce the finished core. The extension and plug lifted away, left the core ready for testing.

generally in the form of a small explosion which marks a very definite instant of time in contrast to the time when the gas begins to burn quietly. Readings of time were invariably taken at both the first explosion and time of quiet burning, and an attempt was made to find a simple relationship between these times, without success. The time of explosion was corrected to what it would be at 10 cms. gas pressure.

The manometer shown in Fig. 26, which reads one way, was found much more convenient to use than that supplied with the apparatus, and an accurate reading of the gas pressure is

green permeability tests are shown to differ very little. The compression-made cores were dried and retested, and again the change in permeability due to drying is seen to be practically nil.

Description of Milling Plant.

From the results obtained with the temporary arrangement the firm decided to put in a sand mixer. The mill installed (Fig. 28) is a well-known type having a stationary pan, with revolving gear carrying the rollers and scrapers, and a disintegrator fitted into the discharge shute at the bottom. The rollers are free to rise and fall, and there is ample provision for adjusting the scrapers as well as the height of the rollers above the bottom of the pan.

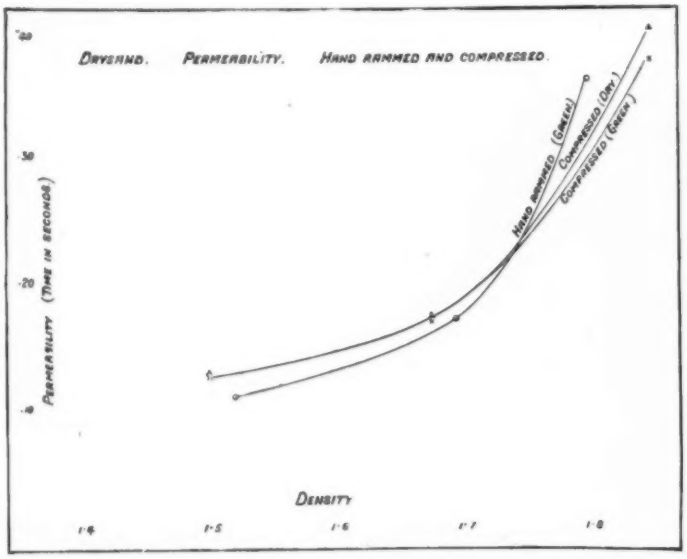


Fig. 27.—Showing the Negligible Difference in Permeability when Hand-Rammed and when Compressed Specimens are Used.

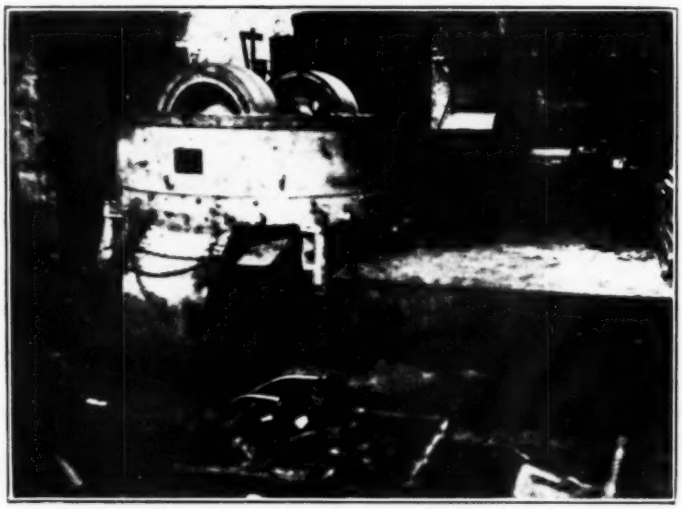


Fig. 28.—Type of Mill Installed as a Result of the Experiments Described.

Thus, the core had a definite density, and daily tests done in this way compare without further trouble. This method is quite suitable for green-sand testing, the total time required for one test being about 4 min.

In dry sand the permeability test done in the green state may be of little value, since the sand is dried before use, and it is therefore desirable to understand what happens on drying. The method adopted for testing dry was as follows: A brass cylinder (Fig. 24) was made, having a difference of $\frac{1}{8}$ in. in the bore from top to bottom, the mean diameter in the middle of the cylinder being the same as before. This gave a slight taper, but maintained the volume as before.

After ramming up either by hand or compression, the core was removed, as shown in Fig. 24. A disc of the size of the small end of the core was placed under the core, so that, by pressing on the cylinder, the core was gently loosened. The coupling, a part of the permeability apparatus, serves to transmit the pressure of the screw evenly round the cylinder.

After drying, a thin sheet of paper was placed round the core and the cylinder replaced (Fig. 25). The final pressure was controlled by a calibrated spring, not because this was necessary in the permeability test, but because the distance which the core moved towards its original position in the cylinder gave some definite idea of the change in volume during drying. Very little has been done on this question as yet.

The permeability test carried out on this dried core gave a very clear idea of the effect of drying, and had the great advantage of being expressed in exactly the same terms as the green permeability.

The measurement of time was taken from the start of the gas flow through the core till the instant of the first appearance of flame,

advisable. In dry-sand tests by compression, each layer or portion of sand should be raked up before the next is added, in order to prevent a parting forming between the sections. Cores made and removed as described can be pressed

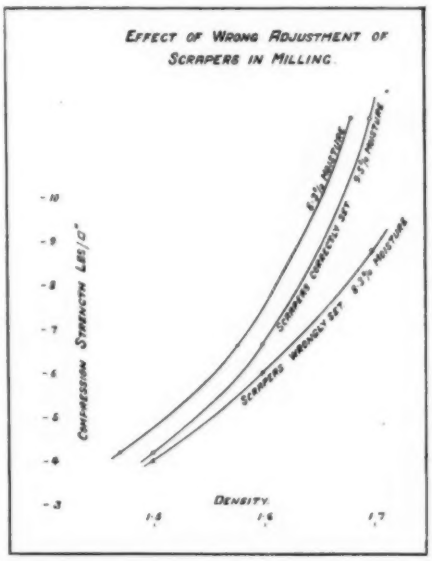


Fig. 29.—Effect of the Adjustment of Scrapers.

out of and into the cylinder a number of times without showing any signs of damage.

The density figure used for a dry core is that of the same core in green state. In Fig. 27 the hand-rammed green and compression-made

In the background is shown a portable sand thrower, which is used in this case to keep the mill supplied with floor sand. The sand, after being moistened, is aerated and mixed by this machine and thrown up in good condition. The floor sand, rock sand and coal dust is shovelled into the mill, and, after allowing five minutes from the time at which the charging is complete, the mill is emptied. A barrow, run under the discharge shute, catches the milled sand which is run into the green-sand bin on the right-hand side, the dry-sand bin being on the left-hand side. The mill is situated in the centre of the foundry between the columns separating two bays and the bins are accessible from both sides. Barrows are used here because crane handling is not very convenient.

Working.

About 35 shovels of sand were found to be the best load for the mill. The parts requiring attention are the scrapers. If these are allowed to wear very much, the sand sticks to the pan, forming a hard cake, which increases the wear on the scraper and at the same time puts extra load on the driving motor due to excessive friction. The scrapers should be used only in their original positions; interchanging, so as to reverse the wearing parts, may seriously reduce the efficiency of the mill. Fig. 29 illustrates this point—*i.e.*, a decided increase in strength is shown after correcting the scrapers.

It is best to make an accurate pattern of each of the scrapers when these are first received and to cast new ones ready for replacement. The scrapers should be adjusted every few days as required and light oiling of the inside of the pan will help to prevent the sand adhering and building up into a cake.

(*Concluded on page* 124.)

The Design of Oil-Fired Crucible Furnaces.

By G. S. Watson.

Coke-fired crucible melting furnaces have had a long and honourable innings in the foundry field. Times are changing, however, and it is becoming increasingly difficult to find furnacemen who will stand up to the arduous conditions of firing and cleaning solid-fuel furnaces. The works manager, apart from his unending fight against dirt, grudges the space occupied by piles of coke and the labour for breaking it and getting rid of ashes. The advent of cheap and reliable supplies of oil has awakened the keenest interest in liquid fuel for metal-melting.

On the experience gained it is possible to lay down certain first principles in oil-fired crucible furnace construction. This article is intended to be of service to those designers who have to embark on the construction of such furnaces. The question can best be studied under the headings of burner, oil-blast inlet, combustion chamber, metal preheating chamber, and waste products outlet.

Burner.

The burner has to fulfil the important function of passing to the furnace a steady stream of oil and air at a rate that can be varied to suit the work to be performed. In most systems of oil-burning, only a portion of the air required for combustion passes through the burner, the balance being induced into the furnace by the injector effect of the stream of blast issuing at high velocity from the burner. It is unusual for a supply of auxiliary air to be blown to the furnace under pressure from a separate source.

Oil Pulverisation.

The oil stream is pulverised by the impact of a jet of escaping air. Steam, though often adopted for marine and other boiler work, is very unsuitable for pulverising the oil for metal-melting furnaces, owing to its damping effect on flame temperature and the reactions that take place between superheated water-vapour in the furnace atmosphere and the molten metal.

Burner Air Supply.

Air at pressures ranging from a few ounces to 50 lbs. per sq. in. can be used, but most burner-makers have adopted the maximum pressure that can conveniently be obtained from a high-speed or two-stage fan, viz., 12 ozs. per sq. in., equivalent to a column of mercury 1½ in. high. With pressures much below this the division of the oil stream is apt to be imperfect, and trouble may be experienced with smoking at starting and deposition of carbon in the combustion space. Very high-pressure air certainly produces a finer oil spray, but compressed-air plant is expensive to install and maintain, and the cost of energy for a given furnace output is much increased.

A pressure gauge should be fitted to the air trunk near the burner. The furnaceman can then satisfy himself that the air pressure is maintained at the amount specified by the furnace-maker as requisite for efficient operation. The gauge connection should be made at a point where there is no risk of the readings being influenced by any eddies or vortices that may be formed when the air-control slide is partially open.

Shape of Jet.

To obtain maximum melting efficiency, the furnace designer must arrange for the development around the base of the crucible of the maximum temperature that metallurgical requirements permit. The intense and localised combustion required to produce high temperature can only be obtained if the oil-flame impinges on hot, non-conducting, emissive surfaces. The space at the designer's disposal, whether in mechanically tilting or stationary furnaces, is generally very limited, and the desired conditions can only be fulfilled if the angle of the jet of oil is made narrow by suitable shaping or grouping of the air nozzle or nozzles of the burner. The best burners generally comprise means for varying the angle of the jet by adjustment of the relative positions of the nozzles within the burner. The narrow-angle jet enters the combustion chamber tangentially and spreads out against the furnace lining around which it wraps itself in its helical passage through the combustion space, centrifugal force causing the bulk of it to scrub the walls of the lining.

Burner Oil Supply.

The oil normally flows to the burner by gravity from a service tank arranged 10 ft. or so above the level of the burner. If the furnace is to be installed in a cold climate, means may have to be provided for warming the oil, though most of the standard fuel oils on the market retain their fluidity at temperatures approaching the freezing point of water. It is wise practice to install a filter screen at some convenient point between the supply tank and the burner.

Direction of Oil Jet.

With a view to ensuring that the maximum temperature of the furnace shall be concentrated around the base of the crucible, the jet should not be allowed to enter with an upward inclination. The burner should be adjusted so that the core of the blast is either horizontal or slightly inclined downwards. Ignition and combustion are generally promoted by the withdrawal of the burner as far as possible from the furnace inlet, the distance back from the furnace being governed by the angle of the jet, and the diameter of the orifice at the injector box.

Warming the Air.

The flame temperature can be increased and a certain amount of oil saved by warming the air supply, but personal experience has shown that the cost of supplying and maintaining apparatus for air recuperation often outweighs the saving of oil. An air-heater in the neighbourhood of the flame escaping at the furnace outlet rapidly scales and burns away, while any device that has to rely on heat passing through the brickwork lining of the furnace takes a long while to warm up and become effective. Variations in the temperature and therefore volume of the air supply cause corresponding variations in the oil : air ratio, with the result that a recuperative furnace requires more attention and control than a similar furnace working on an air supply at atmospheric temperature.

Burner Controls.

The normal method of controlling the heat supply to a furnace consists in passing air to the burner at that pressure found best by trial, the oil supply being regulated to suit such air supply by adjustment of the oil-control gear incorporated in the burner. If the burner is situated in a pit or in any other relatively awkward position it is advisable to fit some form of distant control gear from the working platform, so as to enable the furnaceman to make adjustments with the minimum of effort.

Oil-Blast Inlet.

The blast is preferably passed to the furnace through an injector box, the function of which is to secure thorough ignition of the blast. This box should be proportioned so as to enable a high degree of combustion to be attained before the flame reaches the relatively cool crucible. The speed of combustion depends on the fineness of the fuel particle, the intimacy of its contact with oxygen and the temperature ruling. The best form of injector box comprises a relatively long passage lined with refractory bricks, the latter being maintained at a high temperature by the flame burning in the passage. The heat radiated from these hot bricks aids the ignition and combustion of the oil stream by vaporising the oil particles. The cross-sectional area of the injector box has an important effect on this process. If it is too small the speed of travel of the blast through it is too great and there is not time either for adequate volatilisation of the oil or thorough ignition. If the passage is too large the flame tends to burn back too far towards the blast inlet and the bricks may be destroyed and much heat lost. Furnaces unequipped with an injector box may allow the unfired or imperfectly ignited mixture of oil and air to come in contact with the crucible, to the detriment of economy and crucible life. Cases of defective furnaces have been observed in which the wall of the crucible opposite the blast inlet is heated more by conduction and radiation from the more remote, though hotter, parts of the furnace, than from the flame itself, a condition which may lead to the perishing and splitting of the pot. Apart from this, the fuel consumption per ton of metal will always be relatively high if means are not taken to ensure that the zone of maximum temperature is at the bottom of the furnace.

When a furnace is lit up, ignition and combustion may be sluggish owing to the injector box being cold. It is good practice to introduce means for baffling a little of the oil spray near the blast inlet by means of a rod or wire of small diameter inserted across the jet. This causes small eddies or whirls in the injector passage, and the slight amount of oil : air mixture so disturbed ignites readily in the injector box, warming it up and promoting volatilisation and ignition of the main oil stream.

The injector inlet should be provided with a close-fitting shutter, which should always be shut as soon as the oil supply is stopped for pouring or any other cause. If this opening is left free during standby, the cold air drawn by the chimney effect of the hot furnace will lower the furnace efficiency, and may cause perishing and cooling strains on the crucible.

Combustion Chamber.

The combustion chamber is preferably circular in plan, so as to allow the flame to travel around it in an upward direction helically. It should be built of highly refractory bricks, well backed with insulating material, so as to avoid heat losses from the casing, thereby ensuring a maximum temperature for the surface of the brick face opposed to the crucible, which receives its heat energy mainly by radiation from the lining. Though fuel oils contain traces of metallic impurity or ash which causes a slight degree of glazing or fluxing of the brick, the bulk of the wear on oil furnace linings is caused by metal spilt during careless charging or pouring. The wear of linings due to either cause will be minimised by the use of hard burnt bricks having a high ratio of alumina to silica in their composition. A good-sized drain hole should be provided at the front of a tilting furnace and at the front or in the bottom of a stationary furnace to enable spilt metal to be evacuated promptly. These holes are best plugged with foundry floor sand, which does not burn hard and which can therefore be knocked out easily if leakage has occurred or is suspected.

The width of the combustion space or the difference between the radius of the crucible and the lining is important. If too small, the combustion will be adversely affected, and the rate of travel of the furnace gases will be too high to allow adequate time for them to impart their heat to the system before they reach the furnace outlet. Troublesome deposits of carbon may also be formed on the lining, obstructing the free flow of the blast and impairing furnace efficiency. It is better to err on the large rather than on the small side when deciding on the diameter of the lining, but considerations of space, weight

(*Concluded on page* 120.)

Oil-Sand Practice.*

By B. Gale.

The subject of making moulds and cores from oil-bonded sea sand has been continually discussed during the past few years, and many valuable Papers have been presented; but there are still many who cannot successfully use oil sand in their works. This is due probably, not to the unsuitability of the materials, but to the lack of initiative in assuring the control of the materials. There are, of course, instances of individual attempts to place the control of oil sand on a sound basis, and the Paper given by Mr. F. Hudson contains a mass of data on sand and binder control. To the authors of Papers of this class the foundry industry owes a debt of gratitude, as they outline the laboratory methods in so simple a manner that they can be easily carried out in actual foundry practice. No chemist, however, can lay down a formula that is suitable for all classes of castings, so it is imperative that foundrymen experiment in their own foundries on their own particular class of work.

Before purchasing any core binder or sand, the author insists upon testing samples being submitted, in order to ascertain their suitability for his work, using his own particular methods. No two foundries have identical tackle and methods, and what will be highly successful in one shop may be a distinct failure in another.

The author's firm has been using oil sand for coremaking and moulding for the past 15 years, with a considerable degree of success. Some time ago he visited a neighbouring foundry, which had a splendidly-controlled core department. During conversation it was ascertained that the management condemned the sand the author's firm was using as "rubbish," and by a strange coincidence it was using a sand that had personally been proved a failure. Yet both were highly satisfied with their own particular cores. The reason for this difference was entirely due to the type of binder used, and the different nature of the work undertaken. This conversation has led to a few practical experiments on cores, using different grades of sand, which it is proposed to term fine, medium and coarse, and different kinds of binders. The binders used were as follow:—(1) Oil, which is the thin variety of binder of linseed oil; (2) cream, the liquid binder of the colour and consistency of cream; (3) semi-solid, the stiff paste; (4) gum, the treacly substance, such as wood-pulp extract, etc.; and (5) black oil, the liquid binder closely resembling thin gas tar.

Sands Used.

Sea sand, river-bed sand or rock sands are the main sources of supply, and are generally referred to as "sharp sand." The term "sharp sand" is inclined to be misleading. Sea sand is termed sharp sand, but a microscopical examination will show the grains to be rounded. Frictional action, as the sand is washed or blown out, wears off all the sharp corners.

The chief characteristics of the sand are uniform grain-size and freedom from any natural bonding agent, such as clay. The presence of clay in the sands acts detrimentally on the oil binders, and it will be found that a greater quantity of binder must be used with a sand containing clay, even in small proportion, than will be required with a sand free from natural binding agents. A simple practical test for the presence of bond in a sand may be used by making a core in the sand with water only as the green binding agent. Place the core in the stove, and as the water is driven off, the core will collapse if no bond is present. Even a very small percentage of clay will allow the core to retain its shape after all the water is dried out. Some types of binders do not necessitate sand that is free from clay, and the tests shown in Table I illustrate the effect of clay-bonded moulding-sand additions to sea sand.

Table I.—*Transverse Force necessary to Break 1-in. sq. Core Set on 6 in. Centres.*

Mixture.	Oil.	Semi-solid.	Gum.	Black oil.
40 sea sand : 1 binder ..	38.5	29	24.5	39
30 sea sand : 10 red sand : 1 binder	34	28	22.5	35.5
20 sea sand : 20 red sand : 1 binder	19	25.5	18	24

The method adopted for transverse test is to set the core on two bearings 6 in. apart. A bucket is then suspended to the centre of the core, and gradually filled with lead shot until the core breaks. It is essential that the weighting material is very small, to ensure an accurate reading, and the weighting must be carefully done, to prevent any sudden shock breaking the core.

Effect of Water.

Water plays an important part in the strength of cores, both in the green and the dried state. In oil binders water adds considerably to the dried strength of the core, and where this type of binder is used, and green bond is not essential—wet sand can be used for mixing. Dry sand is undoubtedly the more satisfactory, as the amount of added water can be controlled and constant mixtures adhered to, but it is not thought necessary to go to the expense of drying the sand. In the case of binders used to give a green bond, dry sand must be used. Table II illustrates the effect of water on various binders.

Table II.—*Effect of Water on Various Binders.*

Mixture.	Green drop.	Baked transverse.
	In.	Lbs.
40 sea sand : 1 oil	0.75	38.5
40 sea sand : 1 oil : 2 water	1.0	54
40 sea sand : 1 gum	1.75	22.5
40 sea sand : 1 gum : 2 water	1.0	37.5
40 sea sand : 1 black oil ..	0.75	39
40 sea sand : 1 black oil : 2 water	1.0	50.5

The green strength is taken by sliding a 1-in. sq. cover over the edge of a smooth glass plate, and taking the measurement of the length of core, before and after breaking. The figure given is that length of core that falls off.

Grain-Size.

Uniform grain-size is of utmost importance for successful oil-sand work. The most simple method of testing for grain-size is by the use of a nest of graduated-size sieves. The sample of sand is placed in the top sieve, with the largest mesh. The nest of sieves is then agitated for a given time, and the quantities remaining on each size mesh give an index to the grain-size proportions. If it were possible to have a sand where 100 per cent. remained on one of the intermediate sieves, many of the troubles of coremaking would disappear.

Table III.—*Strength of Cores in Relation to Grain-size.*

Grade of sand.	Baked strength.
Fine	39
Medium	54
Coarse	59

Important though even grain-size may be, the grain-size, whether fine, medium or coarse, is a matter to be decided upon according to the grade of work required, and the type of binder required. The larger the grains the smaller the amount of binder required, as there are fewer contact points to be fastened with the binder. Table III shows the strength of cores in a mixture of 40 sea sand : 1 oil : 2 water, with varying grades of sand. On the other hand, the smaller the grain-size, the smoother the skin produced on the castings. There are many who think that the large-grain sand will give better venting than the small grain, but this is erroneous. Cases are known of mixing fine and coarse sands together, but no real reason exists for this practice. A most striking illustration of the foregoing remarks was presented in a Paper to the 1924 Conference of the Institute of British Foundrymen by Mr. C. W. H. Holmes, who said:

> "If a glass jar that will hold one pint is taken and filled to the brim with marbles of the same size, it will be found that one is still able to pour into the jar between ¼ and ½ pint of water. Now, if we consider these marbles to be grains of sand, highly magnified, we shall see there are considerable spaces between the grains along which the gases can travel, and so long as the particles are rounded and of regular size, it does not matter how big or how small they be, we shall still find the same high percentage of spaces. For instance, if we taken another jar and fill it with No. 5 lead shot, we shall still be able to pour into the spaces between the shot as much water as we could in the case of the marbles. But if we take a third jar, and, after filling with marbles, we run in the lead shot, we shall find that we cannot run in nearly so much water as in the previous cases."

Whilst on the subject of sand, one must consider the high cost of freight of sea sand compared with the local moulding sands, and whether any economy can be effected by the use of reclaimed sea sand. On this subject, it is difficult to see any advantage in using old sand. If one considers that the old sand costs nothing, and 50 per cent. old sand is used in the mixture, there appears to be a saving in the price of the sand, but from experience this is found to be a fallacy. In the first place, does one get the old sand for nothing? Assuming that all the castings are knocked out in the same place, one will have a heap consisting of burnt sea sand in the free state, lumps of partially-burnt cores, core irons, chills, etc., and moulding sand. This has to be riddled to collect all the irons, and then one must either throw away the unburnt cores and sieve the fine sand only, or the whole must go through a crushing mill. It must then be sieved before it can be used for making cores. Is not the cost of reclaiming the sand as much, or nearly so, as new sand? Should one persist in the use of the old sand, one will find that extra binder must be used to produce a good strong core; thus the cost of the binder balances the saving on the sand. In addition to this the cores will be found to have very poor venting properties, as the broken sand grains, and the proportion of moulding sand that is inevitably collected, will clog up the pores in the way illustrated by the lead shot amongst the marbles.

Hudson* has pointed out that American foundrymen have been unsuccessful in their efforts to reclaim oil sand, as the cost of collection of the old sand, and the capital outlay for the plant that must be used to screen and wash the sand grains effectively, is too large, even where vast quantities of sand are required, and where the foundries are situated hundreds of miles from the source of supply. The author has inspected one plant in England where the core sand is reclaimed, but in re-use it is used as

* A Paper read before the Lincolnshire Section of the Institute of British Foundrymen, Mr. J. J. Feasey presiding.

* "The Reclamation of Oil-Sand Cores." Paper read at the 1930 Conference of the Institute of British Foundrymen. See Foundry Trade Journal, July 24 and 31, 1930.

moulding sand only. New sand is used for all the cores.

Choice of Binder.

To decide which type of binder is the most suitable requires considerable thought. Firstly, one must consider the type of work in progress. Oils are quite easily mixed, as the measure can be quickly filled and emptied and keeps perfectly clean. The cores are clean and sharp, and leave the casting quite freely during fettling operations. Where this type of binder can be used, it produces a most satisfactory core. There is, however, a great disadvantage in oil binders, and that is the lack of green bond. Cores of irregular shape, with overhanging pieces, cannot be made in oil binders unless one resorts to the use of formers or packing cradles to support the core until baked, which, of course, adds considerably to production costs.

Creams and gums are much more difficult to mix. It is more difficult to fill and empty the measure, and unless the measure is clean after each mixing of sand, the binder cakes on to the sides of the measure and the subsequent mixings will not have the prescribed amount of binder, with possible disastrous results. The green bond of these cores is somewhat better than the oils, but there is not sufficient bond to justify one to make cores without the use of the formers. There is generally sufficient linseed oil in the composition of the creams to make the cores sufficiently waterproof to withstand ordinary mould dampness, for a short period, but, unlike oils, they could not be left in a mould for any long time before casting, as they would absorb the mould dampness and collapse. The gums, which are the cheapest type of binder, absorb water rapidly and should not be used in any large casting. They are quite suitable for small cores that are to be placed in moulds and cast the same day.

The semi-solids are in a different class. The mixing is similar to creams, but the resulting sand possesses a high green bond, and the cores can be made without the use of formers, etc., with the same freedom that can be used with ordinary clay-bonded core sands. These cores are waterproof, and excel all other core binders for the smoothness of the skin of the baked cores, and for their non-clagging nature. The black oils are similar to oil binders. These are a recent development in core binders, evolved with the object for furnishing a binder with the high strength of the oil core, without the use of the rather costly linseed oil. As no linseed oil is present in the mixture, the cores bake more rapidly than the oils, and they are quite waterproof.

A survey of the characteristics of the various binders will indicate the type of binder required for the particular class of work to be made. Does the work demand green bond, or is it the simple type of coremaking that can readily be turned on to flat plates? Is the baked strength of greater importance, or is it more necessary for the cores to be waterproof after baking? This latter point is one for careful consideration, and applies equally to many types of cores, whether green-bond strength is required or not. Some of the cheaper gum binders will give a suitable green bond, but will go back and collapse if left in contact with the damp sand for any length of time. A simple test for the waterproof qualities of a core sand is to take a sample core—one of the transverse test-bars is very suitable—and place it endways in a receptacle containing 1 in. depth of water. Leave the core so for 20 min. and then take out and test for the amount of the core that has softened due to water absorption. Table IV shows the results of green bond, baked strength and water resistance using different types of binder, mixed at 40 to 1 by volume with sea sand.

Table IV.—*Influence of Different Binders on Properties of Cores.*

Binder.	Baked strength	Green drop.	Water absorption.
	Lbs.	In.	In.
Oil	38.5	0.75	Nil
Cream	30	1.25	0.25
Semi-solid	29	2.25	Nil
Gum	24.5	1.75	Core collapsed
Black oil	39	0.75	Nil

Mixture in all cases 40 sea sand to 1 of binder.

Influence of Baking Time.

Baking time is another point that must be taken into consideration, from the point of view of economy, and also where speed of baking is essential for an urgent job. On this point the oil binders fall into the background; the baking time of oil is quite double that of the semi-solids and gums. Evidence of this fact can be obtained by making a core in each type of binder and placing them in the oven on the same tray, at the same time. It will be found that the semi-solid core can be removed and used, while the oil core is still in the green state. In fact, binders of the semi-solid variety will dry out when exposed to air, a feature that will not occur with the linseed-oil cores. For the types of cores made in the author's works, green bond is not generally essential, and the majority of the cores are made in the black-oil binder, but for cores that are required the same day as ordered, a supply of the semi-solid binder is maintained, principally on account of the speed of baking.

The final point is the price of the binder. This applies especially when one mixes the sand and binder by volume. Core compounds, whether liquids or solids, are generally sold by weight, and it may be that a binder quoted at a low price per cwt. is actually more expensive than a binder quoted at 15 per cent. more per cwt. A comparison of the weight of a measureful of four different proprietary core binders resulted as follows:—Oil, 8 ozs.; cream, 11 ozs.; semi-solid, 14 ozs.; and gum, 16 ozs. Thus, an oil binder at, say, 35s. per cwt. would be cheaper than the gum binder at 20s. per cwt.

What are the features of the mixed sand? Oils are inclined to drip through the heap, with the result that if a heap of sand is left for any length of time it must be remixed by turning over with the shovel once or twice. Semi-solids and gums quickly air-dry, and when in the air-dried state the sand must not be used for coremaking, but must be remilled for about 5 min. To prevent this air-drying, the sand should be kept covered with a damp cloth when not in use, and the sand worked from under the cloth when making cores. It should be ascertained, however, that the cloth is only just damp; if it is too wet, the sand will absorb the moisture and lose its green-bond strength.

Avoiding the Use of Formers.

The sands and binders previously outlined will make practically any type of core, whether in bonded sand or not, but many types of cores, even when made in a bonded sand, would require to be made in a former for support until dried. Where possible, it is far more economical to make the cores in halves on flat plates. An instance of this may be seen in an ordinary globe valve body. The core, when made whole, whether in a bonded oil sand or not, or in a natural-bonded core sand, must be supported during baking. This type of core is the most simple job when made in halves on flat plates. Should the cores be placed in the mould with the core joint horizontally, there is no necessity to join the cores. Perfectly flat plates must be used, and, when baked, two half-cores can be rubbed together and placed in the mould as made without fear of the cores becoming twisted. Should the cores stand vertically in the mould, however, jointing is essential. The method employed in the author's works is partially to bake a half-core, sufficiently to be handled, and then to turn a green half-core on to it and bake the whole core thoroughly. This method is quicker and more satisfactory than baking two half-cores and afterwards jointing, and dispenses with the necessity of using packing pieces and formers. Formers are a very costly item, especially if large numbers of cores are required for supplying a moulding machine. In the case of cores that must be supported, a cheap method of making a former is to make it in oil sand, using an excessive quantity of binder. Many cores can be baked in an oil-sand former before it collapses through overbaking.

Oil-sand mixtures are inclined to clag to the varnish of the core boxes, and the most satisfactory method to overcome that difficulty is to wipe the core box occasionally with a paraffined cloth. To prevent the liability of damaged core faces, due to their sticking hard to the plate when baked, it is good practice to place a sheet of paper between the core and the plate.

In general practice, much of the venting of cores can be eliminated when using oil sand. If sufficient care has been taken to secure uniformly-grained sand, there is a sufficient amount of vent spaces to allow for free and rapid exit of the air and gases. In cases where the bulk of the core is enclosed in the casting and the print area is small, it is advisable to vent, by filing a channel in the joint of the core.

Blackwashing can be largely dispensed with in oil-sand work. When using fine-grain sand, blackwashing is not necessary, as the core will give a good skin to the casting. Should the sand be coarse grained, blackwashing is employed to give the casting a good face. The blacking is simply to fill up the cavities between the coarse-sand grains, and is not required to prevent sand fusion as is the case with natural-bonded core sands.

In the jobbing foundry one often encounters patterns of difficult design for three- or four-part moulding, which must be dried. Oil sand can very often be advantageously used in this connection. In the author's foundry a pattern of this type was sent for two castings. The pattern was split and dowelled for three-part moulding, and no suitable boxes were available. A rectangular core box was secured and the middle part of the pattern was rammed up and finished and dried as a core. When dried the pattern was replaced in the core and the bottom part of the pattern placed in position. This was then rammed up in a deep bottom-part moulding box, and rolled over. The top section of the pattern was then located by its dowels, and the top moulding box rammed up and finished in the ordinary way. The core, containing the middle section of the pattern, was then lifted out, provision for lifting having been made in the grid, to allow for the removal of the bottom section of the pattern and finishing the bottom of the mould. The core after removal of the middle pattern was replaced. Thus, the three-part job was cast in a two-part moulding box. The mould was cast with the top and bottom in green moulding sand, and the dangerous middle part in baked oil sand. The mould was not blackwashed or plumbagoed, and the resultant casting skin was all that could be desired.

Apart from enabling the use of the two-part box, the method is advocated in jobs of this type. The factor of safety is so great that the use of oil sand for moulding cannot be ignored, even should the time be a little greater, but in the case mentioned there was also an estimated saving in time of 20 to 25 per cent. For this class of work the use of a clay-bonded oil sand is recommended, although, as previously stated, the mixture requires more binder. The actual mixture used in the job outlined was 40 parts sea sand, 40 parts red moulding sand and 3 parts black oil. This mixture has an exceptionally strong green bond, the test-piece showing a drop of 2¾ in. In the dried state, these cores are very hard, and will withstand the rough usage in ramming up the core in the mould, etc.

The skin is exceptionally smooth and the casting skin is very good. Blackwashing is unnecessary, and venting can be largely eliminated.

The baking of cores presents a number of difficulties, especially when using thin oils. It is the practice in many foundries to keep the stove at a temperature of about 400 deg. F. (205 deg. C.) and bake the cores for a given time. In the case of semi-solid binders, where no water is present, this is quite good practice, but in any mixture where water is employed difficulties occur. Probably cores must be baked at a temperature of at least 205 deg. C. for successful cores. If cores containing water are placed in an oven raised to this temperature, the intense heat appears to bake the skin of the core quickly, before all the water is evaporated. The accumulating steam must escape and, in so doing, is apt to burst the baked skin of the core. One method of overcoming this difficulty is to use perforated plates, to allow exit of the steam from the underside of the core trays. Another source of trouble, especially when using the old type of stove, is, in the case of large cores, for the outside to be overbaked, while the centre is still green.

In the author's works one of the quick-drying binders is used for cores required the same day. For cores made a day or two in advance an oil binder is used, and the troubles are overcome in the following manner. The stove is filled with green cores, before the fire is lit, actually the last thing at night. The stove is gradually heated up, allowing all the water to be driven off before the heat is raised sufficiently to bake the oil binder. The stove reaches the maximum temperature and then, as the fire dies out, the cores are gradually cooling off. Experience has shown the correct amount of fuel to effect this method of baking, and the following morning sees a stove full of perfectly baked cores, with a minimum of trouble and expense. The core maker can fill and empty the stove in comfort, as it is never necessary for him to enter the stove at a higher temperature than about 150 deg. F. (65 deg. C.)

In conclusion, the author desires to thank his employers, Edward Stevenson, Limited, Nottingham, for allowing him free access to their works and methods, without which the compilation of the Paper would have been impossible.

DISCUSSION.

Opening the discussion, MR. J. J. FEASEY (chairman) said the author had scarcely referred to venting, but what was mentioned seemed to suggest that it was unnecessary. With that point of view he could not agree. For some classes of core venting was essential, and especially in the automobile industry.

The Venting of Cores.

MR. WALTERS said that before taking up the question of venting he would like to be sure of the temperature at which the cores were baked.

MR. GALE replied that in the case of oil-bonded cores the temperature must be 205 to 230 deg. C. for successful practice.

MR. WALTERS then pointed out that at such a temperature there would be a partial combustion of the oil binder, which would leave voids, and thus venting would be somewhat automatic.

MR. FEASEY agreed that there was automatic venting, but in some cores actual venting was essential. He found that in a shop with a large variety of cores it was better practice to vent every core. There was more likelihood of trouble from lack of vents than the use of vents.

MR. GALE agreed that in certain cores venting was essential. He instanced a small gilled condenser casting, having a 2¼-in. dia. by 6-in. long core enclosed in the body of the casting, the only exit for the air and gases being three ¾-in. dia. core prints. Unless venting was used it would be impossible to produce successful castings. He thought, however, that in many cases venting was used where it could be eliminated. For instance, in valve work, one had generally three large prints and venting was not needed. Mr. Feasey had mentioned that castings could not be made solid without venting, but for the past six months, making all types of valve work, the author's foundry had not had a waster due to porosity, and no vents had been used.

MR. STEVENSON supported the author's statement, and said far too much time was wasted in useless venting. He had taken up this attitude with a foundryman who insisted on venting. He asked the foundryman to examine the castings before removal of the flash and cores, and it was found that many of the vents were filled with metal. What would be the use of those vents? There was more risk of faulty work than if the cores had been unvented.

MR. COLEMAN said he had made difficult turbo-pump castings where it was impossible to use either vents or wires, and he had been quite successful with the castings. In the case of large cores, he had filled the centre with cokes, which allowed for venting and also effected a saving on the sand.

MR. GALE said it was his practice to use cokes in large cores. Oil sand was a rather expensive material, and in very large cores he frequently made a shell of about 1 in. thickness of oil sand and filled in the centre with cokes and floor sand.

MR. MATHER said that he very seldom vented oil-sand cores. In the case mentioned by Mr. Coleman of the turbo-pump, he would lay a piece of straw in the very thin sections to assist venting. In plain cylindrical cores he never vented.

MR. COLEMAN said his cylindrical cores were vented, and asked whether the author had any experience on that subject. MR. GALE replied that all round cores made by the "sausage" machine were in a 50/50 mixture of sea sand and red sand, which he had found to be the most suitable, it having a strong green bond to allow the machine to push out long lengths of core without distortion. He would vent this mixture, but the machine worm made its own vent.

MR. COLEMAN referred to the use of the semi-solid binders, and said he had adopted this material as the bond given allowed the cores to be moved in the green state. Sands with no green bond required a plate for each core, but the semi-solid allowed the coremaker to pick up the cores and pack a number on one plate, thus saving stove space.

Core-Blowing Machines.

MR. STEVENSON asked whether anyone present had any information on the sand mixtures used for core-blowing machines.

MR. BRYAN replied that he had seen the machine at work on the Continent, and, although he could not get the correct mixture, he thought it to be white Calais sand and resin.

MR. FEASEY stated he had seen core-blowing practice in America, where the mixture was white sand, flour and resin. The mixture was blown into the corebox in the dry state. The machine had one-half corebox attached, and there were hundreds of duplicates of the other half-corebox, each core being baked in the half-box. He did not think the machine would appeal to the ordinary foundry, but it was very useful in mass production. This raised the point of the use of flour in ordinary sea-sand practice, and the speaker said flour could be very dangerous and must only be used in small quantities.

Index to British Standard Specifications.—The 1932 edition of the Index to British Standard Specifications, covering 40 pages, has now been issued. It is a complete subject index, and will be of much assistance to those purchasing engineering and allied material, apparatus and machinery. Copies can be obtained from the Publications Department, British Standards Institution, 28, Victoria Street, London, S.W.1. Price, 1s. 2d. post free. The Institution will be represented at the British Industries Fair, Birmingham (Stand 18 G2), where copies of the Index will be available both for reference and sale.

The Design of Oil-Fired Crucible Furnaces.

(*Concluded from page* 117.)

and cost limit the size to which it is practicable to go, particularly with mechanically-operated tilting furnaces.

Many of the best types of *coke*-fired tilting furnace are made in two sections, the lower part containing the crucible and combustion chamber proper, the upper part capable of being swung aside, receiving the supercharge of metal and fuel, this arrangement being necessitated by the practical difficulty of charging and poking solid a deep mass of solid fuel. With oil firing this difficulty does not arise, and the latest forms of oil-fired furnace comprise a single combustion chamber, deep enough to contain both the crucible and the muffle-ring extension for the supercharge of metal. This simplifies and cheapens the construction of the furnace.

Since with this arrangement it is not necessary to open up the combustion space for charging and pouring, radiation losses are reduced and the furnaceman is saved exposure to undue heat. The best type of furnace gives access to the crucibles by the removal of a small cover, the combustion chamber remaining sealed until such time as the crucible requires changing or the furnace lining needs repair.

Metal Preheating Chamber.

The economy of working will depend to some degree on the course taken by the waste gases in their passage through the upper part of the furnace on their way to the outlet. All metals and alloys are the better for being melted out of close contact with flame, this being particularly the case when they have reached the molten state, in which condition they will readily dissolve gases. The best arrangement of furnace provides for a muffle ring resting on the top of the crucible, when the metal is undoubtedly melted under the best conditions from the metallurgical point of view. Some makers of oil furnaces claim that economy is to be gained by allowing the flame to pass through the supercharge of metal in the muffle ring, but the weight of opinion is against this practice, experience having shown that the slight saving of fuel consumption and time of melting is outweighed by the reduction in the quality of the molten metal.

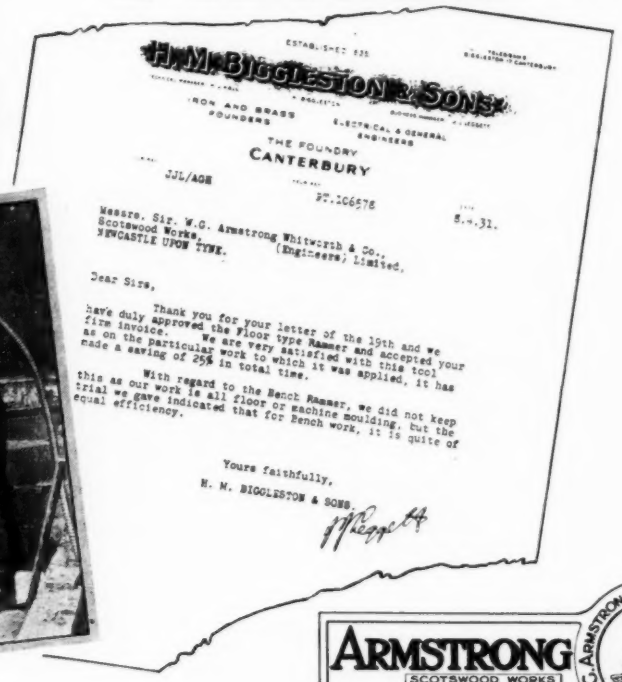
Waste Products Outlet.

The best position for the waste products outlet depends on local conditions. Where there is plenty of head room in the foundry there is generally no occasion to connect the furnace to a flue or chimney, and the waste gases can be allowed to escape into the atmosphere. They will rise quickly and collect in the apex of the roof, from which they can escape through louvres or other types of ventilator.

Apart from the additional cost, connection to a flue involves certain disadvantages. When the furnaceman has got used to his furnace, the size, shape and colour of the flame at the waste-gas outlet will tell him whether his oil and air supply are in correct relationship. This flame is well in sight with the normal system of discharging the waste gases to atmosphere, but when the outlet is connected to a flue it is far less easy to arrange for a flame indication on which to base burner adjustments. Besides this, a furnace relying in part on air induced at the blast inlet will, if coupled to a chimney, tend to vary in operation according to the vacuum or pull on the stack, which in turn varies with its temperature and the climatic conditions. Thus any increase in the chimney draft will pull in more induced air and the oil:air ratio will drop below the correct figure and need adjustment. The area of the waste-gas outlet is also important. Normally this outlet is sufficiently small in size to have a marked effect on the pressure within the surface. Such being the case, any increase in its area will reduce the back pressure.

25% Saving!

FIGURES WHICH TALK!!



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THE FOUNDRY
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8.4.31.

Messrs. Sir. W.G. Armstrong Whitworth & Co., (Engineers) Limited,
Scotswood Works,
NEWCASTLE UPON TYNE.

Dear Sirs,

Thank you for your letter of the 19th and we have duly approved the Floor type Rammer and accepted your firm invoice. We are very satisfied with this tool as on the particular work to which it was applied, it has made a saving of 25% in total time.

With regard to the Bench Rammer, we did not keep this as our work is all floor or machine moulding, but the trial we gave indicated that for Bench work, it is quite of equal efficiency.

Yours faithfully,
H. M. BIGGLESTON & SONS.

Are your Foundry production costs as low as they should be?

Have you considered using Pneumatic Sand Rammers instead of antiquated hand methods? Read this letter and see what users say. There is no better recommendation.

Has our local Service Van called upon you to give a demonstration? If not let us know and we will arrange a visit.

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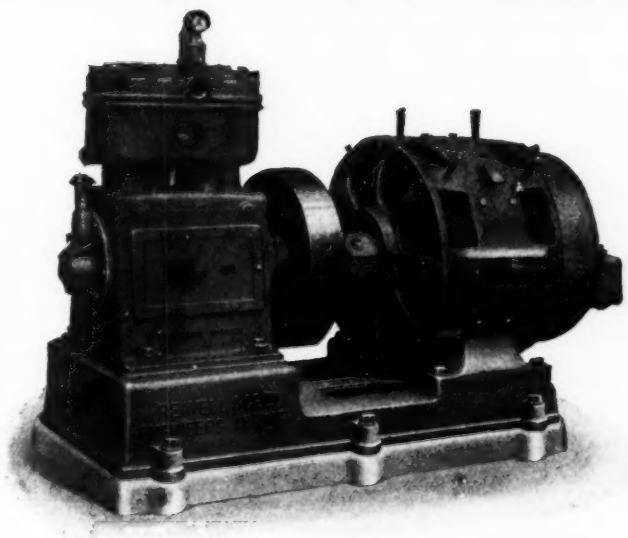

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XUM

This Week's News in Brief.

Trade Talk.

The Furness Shipbuilding Company, Limited, Haverton Hill-on-Tees, has secured an order for a tanker of 2,800 tons deadweight, to be built for Canadian owners.

Messrs. Stewarts & Lloyds, Limited, have received an order from the Ayr Town Council, to the value of £14,700, for pipes in connection with an extended water scheme.

The manufacturing and selling rights of the Vickers works projection microscope have been taken over by Messrs. Cooke, Troughton & Simms, Limited, and Messrs. Wild-Barfield Electric Furnaces, Limited, have been appointed distributors.

The Union Castle liner "Walmer Castle" has been purchased by Messrs. Hughes, Bolckow & Company, Limited, Blyth, for demolition. Built at Belfast in 1902, the "Walmer Castle" is a steamer of 12,546 tons gross, 570 ft. long, and 64 ft. in breadth.

Messrs. Henry Robb, Limited, Leith, have launched a cargo and passenger steamer, "Gothland," of 1,400 tons, for the Leith, Hull & Hamburg Steam Packet Company, Limited. The vessel is intended for the Leith and Hamburg trade, and the main propelling machinery will be supplied by Barclay, Curle & Company, Limited.

At the Birmingham Section of the British Industries Fair it is expected that there will be 263 exhibitors in the hardware, ironmongery and brassfoundry group, 142 in the metals group, 72 in the mining, quarrying and road-making group, 183 in the engineering, machinery and power plant group, and 96 in the electrical plant and accessories group.

The growing unemployment in France was the subject of a debate in the French Chamber one afternoon recently. The latest unemployment figures show that the number of persons in receipt of relief from the local funds has risen to 225,824. This figure admittedly represents only a fraction of the number unemployed, which is generally estimated to be well over 1,000,000.

Messrs. Lithgows, Limited, have launched from their Port Glasgow yard the passenger- and fruit-carrying steamer "Jamaica Progress," built for the Jamaica Banana Producers' Association, Limited. The vessel is 405 ft. in length, 54 ft. in breadth and 33 ft. in depth. David Rowan & Company, Limited, are fitting quadruple-expansion engines on the Yarrow, Schlick & Tweedy system.

The first launch of the year on the Tyne took place recently from the Walker shipyard of Messrs. Swan, Hunter & Wigham Richardson, Limited, the vessel being the "El Kantara," built to the order of the Compagnie de Navigation Mixte, of Marseilles, for passenger service between Port Vendre and Algiers. The vessel is about 400 ft. in length, and has a deadweight carrying capacity of 1,400 tons. She is fitted with turbine engines.

Fire broke out in the Berlin blacking department of the Torwood Foundry of Messrs. Jones & Campbell, Limited, Larbert, on February 10. The roof of the building was burning briskly when the alarm was given, but the prompt action of the local railway station fire brigade prevented the fire spreading to other departments. A considerable amount of damage was done to the building and a large quantity of material, much of it in the finished state, was damaged. It will, however, in no way affect the business of the concern.

The annual dinner of the London Iron and Steel Exchange, which will be held at the Dorchester Hotel, Park Lane, London, W.1, on February 24, is always a popular function. This year Sir Robert Horne, M.P., will be the principal guest, and among other guests will be Mr. Evan Williams, President of the Mining Association of Great Britain; Sir William Larke, director of the National Federation of Iron and Steel Manufacturers; Major Beaumont Thomas, M.P.; Mr. A. N. McQuisten, Mr. Ben Walmsley, and other prominent members of the iron and steel trades. An interesting variety programme has been arranged.

In the course of a record of progress during 1931, the General Electric Company, Limited, states that several large power schemes have been carried out, one of these consisting of the installation of a 37,500-k.v.a. 300-r.p.m. turbo-alternator, together with 11,000-volt metal-clad switchgear, for the Borough of Battersea. A third turbo-alternator set of 37,500-k.v.a. output at 1,500 r.p.m., was built for the Hams Hall power station, Birmingham, and a 30,000-k.v.a. 300-r.p.m. turbo set for the neighbouring Nechells Station, this being the sixth G.E.C.-Fraser & Chalmers set for this station. In both cases the contract included main switch and control gear. Of the many generating units built in the period under review, one of the most interesting was the 4,000-k.v.a. 514-r.p.m. water-wheel alternator for the hydro-electric plant at Pierre's Brook, Newfoundland. This machine has to run in a station where there is usually no attendant. Several large alternating-current electric winders have been put in hand for North-East Coast collieries, one being the largest ordered for this district. Two induction winding motors of 2,500 and 1,500 h.p., with control gear, have been shipped for South African gold mines. Large switchgear contracts obtained during the year include that for the Central Electricity Board in connection with the South-West section of the "grid." The work involves the manufacture and erection of eleven 132-k.v. outdoor sub-stations. Apart from work in connection with the "grid," a large number of extra-high-tension units have been manufactured for export. Bliss-type cluster rolling-mills are now being manufactured, and those actually in service are achieving gratifying results. It is possible with this type of mill for sheets up to 50 in. wide to be rolled by cold-rolling methods.

Personal.

The Hon. Roland D. Kitson, deputy chairman of Messrs. Dorman, Long & Company, Limited, sailed for Australia on February 6 to represent his firm at the opening of the Sydney Harbour Bridge on March 19.

Mr. Arthur Dorman has been elected a Vice-President of the Iron and Steel Institute, and Captain H. Leighton Davies, of Guest, Keen, Baldwins, Limited, and Dr. A. McCance, managing director of the Clyde Alloy Steel Company, have been elected members of Council.

Mr. John C. Wright, managing director of the Burnbank Foundry Company, Limited, Falkirk, has just completed 50 years' service with the firm. Last Thursday he was presented with a roll-top desk from the employees, and a cheque from the directors and shareholders, of the company.

Mr. T. S. Hammond, the president of the Whitney Corporation of Harvey, Illinois, has been nominated for the position of President of the American Foundrymen's Association, and Mr. Frank J. Lanahan, the president of the Fort Pitt Malleable Iron Company, of Pittsburgh, for the position of Vice-President.

Obituary.

The death occurred in Vancouver, on February 4, of Mr. George Ure Gillespie, late of Gillespies, Limited (now Mitchell, Russell & Company, Limited), Bonnybridge.

Company Reports.

Allen West & Company, Limited.—Loss of £30,160, reducing the credit balance brought in to £25,655, of which £15,000 is placed to depreciation reserve and the balance carried forward.

Sentinel Waggon Works, Limited. — Profit, £22,453; depreciation, £12,024; written off experimental and development expenditure, £4,441; transferred from reserve fund, £5,000; brought in, £2,427; carried forward, after payment of preference dividend, £2,166.

New Companies.

Aluminium & Non-Ferrous Foundry, Limited.—Capital, £2,000. Director: Mrs. G. A. Howse, 11a, The Crescent, Surbiton.

Birmingham Refractories, Limited, 53, Solihull Lane, Hall Green, Birmingham.—Capital, £100. Directors: D. and Mrs. S. Pitt.

Company Meeting.

Stewarts & Lloyds, Limited.—Extraordinary general meetings of holders of each class of share of Messrs. Stewarts & Lloyds, Limited—6 per cent. cumulative preference, preferred ordinary and deferred—and an extraordinary general meeting of the company were held in Glasgow on February 8 to pass the special resolutions required to give effect to the agreement entered into with the Scottish Tube Company, Limited, to acquire the shares of that company in exchange for shares in Stewarts & Lloyds, and also to pass the necessary special resolutions for splitting the existing 6 per cent. cumulative preference shares of £10 each and 10 per cent. preferred ordinary shares of £10 each into shares of £1 each to be known as cumulative first preference shares and cumulative second preference shares respectively. At each of the class meetings the shareholders approved of the resolutions in so far as they affected their rights. Mr. A. Macdiarmid (the chairman), in addressing the general meeting, at which also the motions were carried, said that the object of the proposed increase in the capital of the company was to enable them to acquire the business of the Scottish Tube Company, Limited, by an exchange of shares. The terms of the proposed exchange were in the opinion of the directors fair and reasonable. The business they proposed to take over was on similar lines to their own, and they confidently believed that the result of its acquisition would be to increase their competitive strength in the world's markets and their dividend-earning capacity.

B.C.I.R.A. Elects New Members.

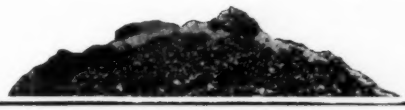
The following firms have joined the British Cast Iron Research Association as ordinary members. The representative is shown in brackets after the name of the firm: Carntyne Steel Castings Company, Renfrew (Mr. J. D. Wilson); W. C. Holmes & Company, Limited, Huddersfield (Mr. D. M. Henshaw); Jones & Attwood, Limited, Stourbridge (Mr. E. R. Jones); Radiation, Limited, London (Mr. H. James Yates); John Wright & Eagle Range, Limited, Birmingham (Mr. J. F. Davies); Davis Gas Stove Company, Limited, Luton (Mr. H. N. Davis); Richmonds Gas Stove Company, Limited, Warrington (Mr. H. M. Thornton); Fletcher, Russell & Company, Limited, Warrington (Mr. Wm. Russell); Wilsons & Mathiesons, Limited, Leeds (Mr. Wm. Mathieson); The London Scottish Foundry, Limited, Barking (Mr. W. D. Mathieson), and Workington Iron & Steel Company, Workington (branch of the United Steel Companies, Limited), (Mr. J. C. Jones).

Cast-Iron Roads.

The Stanton Ironworks Company, Limited, near Nottingham, are putting on the market cast-iron road sections which they have developed during the past 18 months, and which they have tried out under heavy commercial traffic conditions at Stanton, West Ham, Islington and Millwall.

These sections, when laid on a concrete foundation, are intended to meet the difficult conditions encountered in present-day road-making practice, and can be guaranteed to give a permanent roadway with freedom from wear. Up to the present, granite setts have been largely used for meeting these difficult problems, but the Stanton road, built up entirely of cast-iron sections, is more durable, whilst at the same time offering the advantage of being some 20 per cent. cheaper than roads built of granite setts.

Influence of Antimony on Aluminium Alloys.—Mr. A. W. Bonaretti in "Metalli Leggeri et Loro Applicazione" shows that quaternary alloys of the Al-Mn-Mg-Sb type have opened up a new field, having wide possibilities where corrosive agents would preclude the use of the usual light alloys. The Intelligence Department of the British Aluminium Company, Limited, Adelaide House, King William Street, London, E.C.4, has full technical information available as to the developments.



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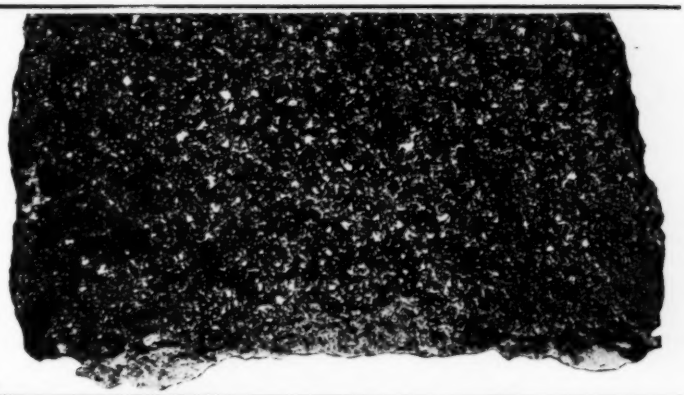

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Raw Material Markets.

Business is sluggish in the pig-iron markets, but deliveries against current contracts are steadily maintained. Trading in finished steel has been of a hand-to-mouth nature, but is gradually increasing in volume.

Pig-Iron.

MIDDLESBROUGH.—The market remains firm, in spite of the lack of demand from consumers. There is a more optimistic tone as a result of the new tariff, but the local industries have yet to show any improvement. On the other hand, the export position has shown a definite improvement, and shipments of iron so far this month are showing a gratifying increase. Prices remain at the minimum and are as follow:—No. 3 Cleveland G.M.B., 58s. 6d.; No. 1 foundry, 61s.; No. 4 foundry, 57s. 6d.; No. 4 forge iron, 57s. per ton.

Domestic consumption in the East Coast hematite market remains low, and there are heavy stocks of unsold iron. More business has been done by local merchants on export account, several tonnages being shipped to Europe. The average price of mixed numbers is now 64s. per ton, with No. 1 quality at 64s. 6d., but business is reported at rather less in each case. In the West Coast hematite market, the demand is so low that the Barrow Hematite Steel Company is to damp down its two furnaces this week-end. Local consumption is restricted, and the demand from the Continent, the Midlands and South Wales is likewise only moderate. Bessemer mixed numbers are quoted at 66s. per ton at works.

LANCASHIRE.—Steady deliveries of foundry iron are being made to consumers in this area, but the volume of new business remains disappointing. Prices are steady, with Midland foundry makes offered for delivery to users in the Manchester price zone at 67s. per ton, North-East Coast at 67s., Northamptonshire at 65s. 6d., Derbyshire forge iron at 62s., Scottish pig-iron at about 87s. and West Coast hematite at 81s. Indian iron for delivery over the next few weeks is offered for delivery in the Manchester area at about 77s. 6d. per ton.

MIDLANDS.—Pig-iron consumers in this district are finding little demand for their products, and the pig-iron market is correspondingly sluggish. For delivery to Birmingham and Black Country stations, makers continue to quote 62s. 6d. for Northants No. 3 and 66s. for Derbyshire, North Staffordshire and Lincolnshire No. 3.

SCOTLAND.—Business in pig-iron remains on a limited scale, but prices are steady. Producers are relieved to find that iron ore is to be excluded from the 10 per cent. *ad valorem* tariff. No. 3 Scottish foundry remains at 69s. 6d. per ton, with 2s. 6d. extra for No. 1. No. 3 Cleveland iron remains at 60s. per ton at Grangemouth, with other English makes at about 2s. per ton less.

Coke.

In the Midlands area foundry coke is experiencing a quieter demand, as the local foundries are finding business difficult to secure. The output of furnace coke is still much restricted, and there is a good demand. Prices (f.o.t. Birmingham) are as follow:—Best Welsh, 32s. to 39s. 6d.; second quality, 29s. to 32s. 6d.; best Durham, 34s. to 37s. 6d.; furnace, 21s. 6d. to 24s. 6d.

Steel.

The demand for finished steel remains very limited, particularly in the shipbuilding areas. There is little improvement in the heavy engineering industry. The steel-bar market is the steadiest of all, and a quiet demand has developed. The semis market remains steady. In the Continental section last week's spurt of prompt buying has died away, and the market is inactive. More orders are being secured by the home works.

Scrap.

Business has slowed down in the Cleveland scrap iron and steel market, and the demand is quiet, the local foundries finding business difficult to obtain. Small parcels of heavy cast iron are being bought at 45s. per ton. Light cast iron is weak at 38s., while machinery quality remains at 47s. 6d. The demand for scrap iron in the Midlands remains limited, and prices are inclined to weaken. Machinery metal in cupola sizes is offered at 47s. 6d. to 50s. delivered, good heavy metal at 42s. 6d. to 45s. delivered, and light metal at 40s. delivered. In the Welsh and Scottish markets prices of scrap iron are inclined to sag, and the supply greatly exceeds the demand. Merchants have great difficulty in persuading consumers to take deliveries.

Metals.

Copper.—The American copper market slumped badly last week, under the pressure of continued selling from outside sources, and Thursday's c.i.f. quotation was 6⅛ cents. The United States Government then announced its proposals for an inflation policy, and the market instantly showed a recovery. The Exporters at once raised their c.i.f. quotation to 6⅜ cents. Another favourable factor is that the cheap offers of second-hand metal, that had forced down the market, have now been withdrawn in the majority of cases. A more cheerful sentiment all round is prevailing in the London market.

Closing quotations :—

Cash.—Thursday, £35 6s. 3d. to £35 7s. 6d.; Friday, £36 15s. to £37; Monday, £38 10s. to £38 12s. 6d.; Tuesday, £37 17s. 6d. to £38; Wednesday, £38 15s. to £38 17s. 6d.

Three Months.—Thursday, £35 3s. 9d. to £35 5s.; Friday, £36 11s. 3d. to £36 12s. 6d.; Monday, £38 5s. to £38 7s. 6d.; Tuesday, £37 6s. 3d. to £37 7s. 6d.; Wednesday, £37 17s. 6d. to £38.

Tin.—The tin market in general will not be directly affected by the new tariff, as nearly all the tin consumed in this country is either English or Straits. Tin ores are also to be admitted free of duty. Meanwhile, in the home market, there has been no improvement in the demand from consumers, and the market is largely ruled by sentiment. Last Thursday standard touched £136 2s. 6d., a record low price for the new year. Sentiment was favourably affected at Friday's market by the rally on Wall Street and by the news that Straits metal had been meeting with increased sales in New York.

Official closing prices :—

Cash.—Thursday, £136 2s. 6d. to £136 5s.; Friday, £138 2s. 6d. to £138 7s. 6d.; Monday, £140 12s. 6d. to £140 15s.; Tuesday, £139 10s. to £139 12s. 6d.; Wednesday, £140 10s. to £140 15s.

Three Months.—Thursday, £138 17s. 6d. to £139 2s. 6d.; Friday, £140 17s. 6d. to £141 2s. 6d.; Monday, £143 10s. to £143 12s. 6d.; Tuesday, £142 5s. to £142 7s. 6d.; Wednesday, £143 7s. 6d. to £143 10s.

Spelter.—The market remains steady in spite of a slack demand. Prices showed an improvement over the week-end, in common with other metals, but buying by consumers shows no improvement. Before last Friday's holiday in New York, the price of spelter touched the record low level of 2.80 cents per lb. at St. Louis. The position of the spelter market on the Continent is disappointing and sales are on a small scale. The immediate prospects are not very hopeful.

Daily fluctuations :—

Ordinary.—Thursday, £13 11s. 3d.; Friday, £14; Monday, £14 6s. 3d.; Tuesday, £14 7s. 6d.; Wednesday, £14 8s. 9d.

Lead.—The lead market shared in Friday's common improvement, but there has been little increase in actual consumption. Sales to home consumers have been small, and the majority are covered for some weeks ahead. In view of the new tariff, it is interesting to note that, of the 21,363 tons of lead imported last month, only 9,982 tons were contributed by Australia and Canada, the two largest producers in the Empire.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £14 13s. 9d.; Friday, £14 16s. 3d.; Monday, £15, Tuesday, £14 18s. 9d.; Wednesday, £15.

Sand Testing in the Foundry.

(*Concluded from page* 116.)

Results Obtained.

The foundry "returns" show that before sand milling was introduced 1 ton of rock sand was used in the production of 5.4 tons castings, whereas since sand milling has been carried on 1 ton of rock sand is used to produce 11.1 tons castings. This saving of roughly 50 per cent. rock sand is in itself sufficient justification for the installation of milling plant, and sand testing properly carried out beforehand should indicate that economy is possible with sand treatment. Notwithstanding this substantial economy in new sand, the greatest saving should be obtained in wages on most types of light work, especially when this is done in plate-moulding, as here the value of the sand used is a very small fraction of the wages expended, and an increase in bond strength has a pronounced effect on the time required repairing moulds.

The author is deeply appreciative of the permission accorded by the Mirrlees Watson Company, Limited, Glasgow, for their kind permission to publish these notes.

Publication Received.

Refractories Bulletin No. 2.—Issued by John G. Stein & Company, Limited, Bonnybridge, Scotland. This is devoted to the origin, development and use of Seger cones.

When using oxygen for metal cutting, every ½ per cent. increase in purity above 98.5 per cent. reduces the oxygen consumed by 10 per cent.

New X-ray Tube.—By substituting glass ¼-in. thick in place of the usual $\frac{1}{64}$-in., by changing the geometrical design and by increasing the water cooling of the target, research engineers of the General Electric Company, Schenectady, N.Y., have found it possible to increase voltage at which the tube can be operated from the former maximum of 200,000 to a present 300,000 volts and higher. X-ray pictures through 4 in. of steel can be made in 15 min., compared with the several hours previously required.—"Steel."

U.S. Steel Corporation Earnings.—Total earnings of the United States Steel Corporation for the fourth quarter of 1931 were $3,970,920, compared with $9,181,091 for the third quarter, $13,817,524 for the second quarter, and $19,464,836 for the first quarter. The earnings of the poorest quarter in 1921 (the third) were nearly $21,000,000. Making allowances for depletion, depreciation and obsolescence of $11,988,190 and bond interest of $1,357,489, there was a deficit for the quarter of $9,374,759. Special income from the sale of fixed property and net adjustments of various accounts totalled $4,997,961, reducing the deficit to $4,376,798. The directors reduced the dividend on the common stock from $1 to 50 c. a share.—"The Iron Age."

British Electrical Manufactures in Argentina.—On Thursday, February 4, H.R.H. the Prince of Wales received Mr. Victor Watlington, chairman of the Council of the British Electrical and Allied Manufacturers' Association, who informed the Prince that the electrical industry of the United Kingdom has decided to appoint a representative who will reside in Buenos Aires and will be qualified commercially and technically to represent the joint interests of electrical manufacturers as exporters to the Argentine. This appointment has the active support of the Government, and is intended to follow up the work inaugurated at the British Empire Trade Exhibition which was opened by the Prince of Wales in Buenos Aires in March, 1931. The Prince expressed his satisfaction that an important modern industry intends to put to a practical test the suggestion originally made in the report of Lord D'Abernon's Mission to South America, and since endorsed by the Overseas Trade Development Council, by a number of industrial leaders, and by His Royal Highness himself, that modern conditions demand co-operative action in dealing with export markets.

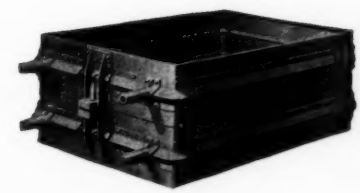
Service Sterling

SOLID RIBBED ROLLED STEEL
MOULDING BOXES

This advertisement is an appeal to those foundrymen who for various reasons have not yet used Sterling Boxes and proved their merits.

To such new friends we venture to say:—permit us to help you to enjoy that carefree experience which follows the installation of Sterling Boxes in your foundry. It is our wish to place at your disposal the full resources of our organisation and to help solve for you any problems associated with the employment of moulding boxes.

Many hundreds of foundries in this country and overseas have proved the superiority of the Sterling Box over all other types, and the volume of repeat orders received from these users is genuine testimony that Sterling Boxes are not only the best boxes but are also the cheapest when all facts are considered.



STERLING FOUNDRY SPECIALTIES LIMITED, BEDFORD

London Office:— 13, Victoria Street, S.W.1.

Agents at:— MANCHESTER. GLASGOW. NEWCASTLE-ON-TYNE.

TELEGRAMS: "STERFLASK, BEDFORD" TELEPHONE: 3345 BEDFORD.

CODE: WESTERN UNION

WEEKLY PRICE CURRENT.

COPPER.

	£ s. d.
Standard cash	38 15 0
Three months	37 17 6
Electrolytic	42 0 0
Tough	40 0 0
Best selected	40 10 0
Sheets	72 0 0
India	49 15 0
Wire bars	43 0 0
Do., March	43 0 0
Do., April	43 0 0
Ingot bars	43 0 0
H.C. wire rods	45 10 0
Off. av. cash, Jan.	39 10 1½
Do., 3 mths., Jan.	39 12 9½
Do., Sttlmnt., Jan.	39 9 7½
Do., Electro, Jan.	47 1 6
Do., B.S., Jan.	41 16 10½
Do., wire bars, Jan.	47 19 0
Solid drawn tubes	11d.
Brazed tubes	11d.
Wire	7½d.

BRASS.

Solid drawn tubes	9½d.
Brazed tubes	11½d.
Rods, drawn	8½d.
Rods, extd. or rlld.	5½d.
Sheets to 10 w.g.	8½d.
Wire	8½d.
Rolled metal	7½d.
Yellow metal rods	5½d.
Do. 4 × 4 Squares	6½d.
Do. 4 × 3 Sheets	6½d.

TIN.

	£ s. d.
Standard cash	140 10 0
Three months	143 7 6
English	141 15 0
Bars	142 15 0
Straits	142 7 6
Australian	141 0 0
Eastern	146 0 0
Banca (nom.)	155 10 0
Off. av. cash, Jan.	140 5 6½
Do., 3 mths., Jan.	143 6 3
Do., Sttlmt., Jan.	140 5 4½

SPELTER.

	£ s. d.
Ordinary	14 8 9
Remelted	13 5 0
Hard	11 10 0
Electro 99.9	16 15 0
English	15 5 0
India	13 10 0
Zinc dust	23 0 0
Zinc ashes	3 15 0
Off. aver., Jan.	14 12 6
Aver. spot, Jan.	14 8 3¾

LEAD.

	£ s. d.
Soft foreign ppt.	15 0 0
English	17 0 0
Off. average, Jan.	15 2 1½
Average spot, Jan.	15 1 8½

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	24 10 0
Do., V.M. ex-whf.	23 0 0
Rods	29 0 0
Boiler plates	—
Battery plates	—

ANTIMONY.

	£ s. d.
Special brand, Eng.	40 0 0
Chinese (nom.)	29 0 0
Crude	22 0 0

QUICKSILVER.

	£ s. d.
Quicksilver (nom.)	17 12 6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£6 17 6
45/50%	£9 17 6
75%	£16 10 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free, 4/2, plus 55%, per lb. of Mo.	
Ferro-titanium—	
23/25% carbon-free	11¼d. lb.
Ferro-phosphorus, 20/25%	£9 17 6
Ferro-tungsten—	
80/85%	1/8½ lb. plus 20%
Tungsten metal powder—	
98/99%	1/11½ lb. plus 20%
Ferro-chrome—	
2/4% car.	£34 10 0
4/6% car.	£24 2 6
6/8% car.	£23 0 0
8/10% car.	£22 10 0
Ferro-chrome—	
Max. 2% car.	£36 15 0
Max. 1% car.	£43 0 0
Max. 0.70% car.	£52 0 0
70% carbon-free	11d. lb.
Nickel—80/99.5%	£240 to £245
Ferro-cobalt	10/3 lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	3/- lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £ 9 0 0
Metallic manganese—	
94/96% carbon-free	1/6 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 5/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ¼ in. × ⅛ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£ s. d.	£ s. d.
South Wales—		
Heavy steel		2 6 0
Bundled steel and shrngs.		1 17 0
Mixed iron and steel	2 0 0 to 2	2 0
Heavy cast iron	2 6 6 to 2	7 0
Good machinery for foundries	2 10 0 to 2	12 0
Cleveland—		
Heavy steel		2 0 0
Steel turnings		1 12 6
Cast-iron borings		1 6 0
Heavy forge		2 17 6
W.I. piling scrap		2 10 0
Cast-iron scrap	2 5 0 to 2	7 6
Midlands—		
Light cast-iron scrap		2 0 0
Heavy wrought iron		2 12 6
Steel turnings, f.o.r.		1 2 6
Scotland—		
Heavy steel		2 2 0
Ordinary cast iron		2 10 0
Engineers' turnings		1 11 6
Cast-iron borings		1 12 0
Wrought-iron piling		2 6 6
Heavy machinery		2 15 0

London—Merchants' buying prices delivered yard.

	£ s. d.
Copper (clean)	30 0 0
Brass	21 0 0
Lead (less usual draft)	12 0 0
Tea lead	9 0 0
Zinc	6 10 0
New aluminium cuttings	62 0 0
Braziery copper	27 0 0
Gunmetal	26 0 0
Hollow pewter	90 0 0
Shaped black pewter	70 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	64/6
Hematite M/Nos.	64/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	73/-
„ d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs common*	—
„ No. 4 forge*	61/-
„ No. 3 fdry.*	66/-
Shrops basic	—
„ Cold blast, ord.	—
„ „ roll iron	—
Northants forge*	57/6
„ fdry. No. 3*	62/6
„ fdry. No. 1*	65/6
Derbyshire forge*	61/-
„ fdry. No. 3*	66/-
„ fdry. No. 1*	69/-
„ basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	72/-
„ No. 3	69/6
Hem. M/Nos. d/d	68/6
Sheffield (d/d district)—	
Derby forge	58/6
„ fdry. No. 3	63/6
Lincs forge	—
„ fdry. No. 3	63/6
E.C. hematite	74/-
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
„ fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	87/-
Clyde, No. 3	87/-
Monkland, No. 3	87/-
Summerlee, No. 3	87/-
Eglinton, No. 3	87/-
Gartsherrie, No. 3	87/-
Shotts, No. 3	87/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£ s. d.	£ s. d.
Bars (cr.)	9 15 0 to 10	0 0
Nut and bolt iron	8 7 6 to 8	10 0
Hoops	10 10 0 to 12	0 0
Marked bars (Staffs) f.o.t.		12 0 0
Gas strip	10 10 0 to 12	0 0
Bolts and nuts, ¾ in. × 4 in.		12 5 0
Steel—		
Plates, ship, etc.	8 15 0 to 8	17 6
Boiler plts.	8 12 6 to 9	12 6
Chequer plts.		10 7 6
Angles		8 7 6
Tees		9 7 6
Joists		8 15 0
Rounds and squares, 3 in. to 5½ in.		9 7 6
Rounds under 3 in. to ⅜ in. (Untested)	8 15 0 & up.	
Flats—8 in. wide and over		8 12 6
„ under 8 in. and over 5 in.		8 17 6
Rails, heavy	8 5 0 to 8	10 0
Fishplates		12 0 0
Hoops (Staffs)		9 10 0
Black sheets, 24g.	8 0 0 to 9	0 0
Galv. cor. shts.	9 10 0 to 10	5 0
Galv. flat sheets	10 0 0 to 11	5 0
Galv. fencing wire, 8g. plain		12 10 0
Billets, soft	5 7 6 to 5	12 6
Billets, hard		6 12 6
Sheet bars	5 0 0 to 5	7 6
Tin bars		5 0 0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	11½d.
Sheet to 10 w.g.	12½d.
Wire	13d.
Rods	11½d.
Tubes	17d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	15.64
No. 2 foundry, Valley	15.50
No. 2 foundry, Birm.	11.00
Basic	16.89
Bessemer	17.89
Malleable	17.89
Grey forge	17.44
Ferro-mang. 80%	75.00
O.-h. rails, h'y, at mill	43.00
Billets	27.00
Sheet bars	26.00
Wire rods	37.00
	Cents.
Iron bars, Phila.	2.11
Steel bars	1.50
Tank plates	1.50
Beams, etc.	1.50
Skelp, grooved steel	1.50
Skelp, sheared steel	1.50
Steel hoops	1.65
Sheets, black, No. 24	2.15
Sheets, galv., No. 24	2.75
Wire nails	1.95
Plain wire	2.20
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	22/6 to 27/6
„ furnace	17/- to 18/-
Durham and Northumberland—	
„ foundry	14/6 to 15/-
„ furnace	14/6
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	14/- to 14/9
„	28×20 „	28/- to 29/6
„	20×10 „	—
„	18¾×14 „	—
C.W.	20×14 „	12/9 to 13/-
„	28×20 „	25/3
„	20×10 „	19/4½
„	18¾×14 „	13/9

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 0 0
Bars, hammered, basis	£16 10 0 to £17 0 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 5 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£18 0 0 to £23 0 0
Bars and rods dead soft, st'l	£10 0 0 to £12 0 0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

TUBES AND FITTINGS.

Current Discounts.

	Tubes.	*Fittings.*
Gas	65%	57½%
Water ..	61½%	52½%
Steam ..	57½%	47½%

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.	
Feb.	11 ..	35	6	3	dec. 8/9
,,	12 ..	36	15	0	inc. 28/9
,,	15 ..	38	10	0	,, 35/-
,,	16 ..	37	17	6	dec. 12/6
,,	17 ..	38	15	0	inc. 17/6

Electrolytic Copper.

		£	s.	d.	
Feb.	11 ..	39	5	0	dec. 15/-
,,	12 ..	41	0	0	inc. 35/-
,,	15 ..	41	0	0	No change
,,	16 ..	42	0	0	inc. 20/-
,,	17 ..	42	0	0	No change

Standard Tin (cash).

		£	s.	d.	
Feb.	11 ..	136	2	6	dec. 17/6
,,	12 ..	138	2	6	inc. 40/-
,,	15 ..	140	12	6	,, 50/-
,,	16 ..	139	10	0	dec. 22/6
,,	17 ..	140	10	0	inc. 20/-

Tin (English ingots).

		£	s.	d.	
Feb.	11 ..	137	10	0	dec. 15/-
,,	12 ..	139	10	0	inc. 40/-
,,	15 ..	142	0	0	,, 50/-
,,	16 ..	140	15	0	dec. 25/-
,,	17 ..	141	15	0	inc. 20/-

Zinc Sheets (English).

		£	s.	d.	
Feb.	11 ..	24	10	0	No change
,,	12 ..	24	10	0	,, ,,
,,	15 ..	24	10	0	,, ,,
,,	16 ..	24	10	0	,, ,,
,,	17 ..	24	10	0	,, ,,

Spelter (ordinary).

		£	s.	d.	
Feb.	11 ..	13	11	3	dec. 3/9
,,	12 ..	14	0	0	inc. 8/9
,,	15 ..	14	6	3	,, 6/3
,,	16 ..	14	7	6	,, 1/3
,,	17 ..	14	8	9	,, 1/3

Lead (English).

		£	s.	d.	
Feb.	11 ..	16	0	0	No change
,,	12 ..	16	15	0	inc. 15/-
,,	15 ..	17	0	0	,, 5/-
,,	16 ..	17	0	0	No change
,,	17 ..	17	0	0	,, ,,

Imports and Exports of Iron and Steel Castings, etc., in January, 1932, compared with January, 1931 and 1930.

	January, 1930.	January, 1931.	January, 1932.	January, 1930.	January, 1931.	January, 1932.
Imports.	Tons.	Tons.	Tons.	£	£	£
Pipes and Fittings, Cast	2,255	1,306	188	28,306	16,779	3,151
Castings, in the Rough, Iron	298	166	23	6,511	3,634	467
,, ,, ,, Steel	1,566	610	247	38,854	13,555	4,173
Hollow-ware, Cast, not Enamelled	4	9	—	505	654	—
,, ,, Enamelled	4	1	—	241	56	32
Exports.						
BUILDERS' CASTINGS—						
To Argentine Republic	218	103	54	8,261	5,222	2,406
,, Irish Free State	379	377	415	17,343	18,640	18,798
,, British South Africa	307	157	196	11,536	6,220	6,824
,, ,, India	177	127	73	6,154	4,324	2,597
,, New Zealand	90	62	21	5,244	4,002	933
Total (including other countries)	1,828	1,281	1,186	78,181	60,474	50,851
PIPES AND FITTINGS—CAST—						
To Argentine Republic	1,429	851	131	13,936	8,067	1,281
,, Irish Free State	810	644	569	12,088	8,215	7,583
,, British South Africa	1,411	936	782	14,372	10,260	9,332
,, ,, India	565	139	102	8,425	3,311	1,688
,, Straits Settlements and Malay States	1,382	77	687	11,859	1,446	6,359
Total (including other countries)	11,887	6,294	5,940	128,951	74,377	68,944
HOLLOW-WARE—						
Cast, not Enamelled, and Cast, Tinned	418	249	166	12,989	7,846	6,011
,, Enamelled	70	38	52	5,862	3,853	4,375
CASTINGS, IN THE ROUGH—						
Iron	407	103	80	11,436	3,708	3,213
Steel	208	154	127	7,065	6,250	4,066

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG

IRON

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

19, ST. VINCENT PLACE, GLASGOW.

ZETLAND ROAD, MIDDLESBROUGH.

SITUATIONS VACANT AND WANTED.

FOREMAN Moulder and Manager for 12 years desires position; age 40; thorough practical loam, dry, green sand, also machine moulding; of proved ability; good organiser; all classes of engineering castings; sound references.—Box 118, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Foreman desires position; 30 years' experience iron and steel, jobbing and mass production; American and Canadian experience.—Box 116, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

METALLURGIST, with wide experience in the manufacture of non-ferrous metals, foundry and rolling-mill practice, desires post as Works Manager.—Box 994, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

REPRESENTATIVE for well-known firm of foundry specialists required for Scotland.—Apply, Box 112, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

A FIRM of Ironfounders and Roll Makers require services of Foundry Manager; good metallurgical knowledge essential.—Box 120, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

FOUNDRY FOREMAN requires similar position, or as Assistant. Wide experience all classes of malleable and cupola practice, marine and general engineering. Age 37. (162)

20 YEARS' experience on electrical and general engineering castings, 2½ years as Foreman in light-castings trade. Thorough knowledge of moulding machines and continuous casting practice. Technically trained. (163)

POSITION of responsibility required by young Foundryman with first-class practical experience, including electrical, turbine, Diesel, and light engineering castings. Sound technical training. Highest recommendations. (164)

FOUNDRYMAN, age 28, requires position as Foreman, Manager's Assistant; has had sound experience as Moulder in high-class engineering castings and in cupola control and mixtures. Good general and sound technical education. (165)

FOUNDRY Manager with wide experience, sound technical training, excellent credentials, is desirous of similar position. (166)

PATENTS AND TRADE MARKS.

PROTECT YOUR IDEAS.—Free, "Advice Handbook" on patenting inventions and registering trade marks by Registered Agent with 45 years' experience.—KINGS PATENT AGENCY, LIMITED, 146a, Queen Victoria Street, E.C.4.

BUSINESS FOR SALE

FOR SALE BY PRIVATE TREATY.
AS A GOING CONCERN.

THE old-established Foundry Business of The General Foundry & Engineering Company, Limited, at Arlesey, Bedfordshire, comprising Freehold Land, Engineering Works and Foundry. Adjoining Three Counties, Station L.N.E. Railway, within easy access of King's Cross; private siding into works. Site area 3 acres, floor area of buildings 22,000 ft. Together with valuable Plant, Machinery, Tools, Stores, Stock-in-Trade and Goodwill. Property and Plant in excellent condition.—Full particulars on application to THE LIQUIDATOR, J. ASH GARLAND, Chartered Accountant, 148, Edmund Street, Brimingham.

PROPERTY.

BRISTOL.

TO Engineers, Founders, Manufacturers.—Fine site of nearly three acres on arterial road, with Foundry and Workshops and own Rail Sidings into the premises. Modern Offices, Warehouses and Workrooms. Central Heating.—CHARLES A. TRICKS & SON, Auctioneers, St. Nicholas Street, Bristol.

MAGNIFICENT

11 ACRES WORKS SITE.

SHEFFIELD.

145,000 Sq. Ft. of Shops.

SIDING CONNECTIONS

with L.M. & S. and L. & N.E. Rlys.

WELL-BUILT & COMMODIOUS OFFICES

Will Sell whole or in lots to suit customers or Let on favourable terms. Unique opportunity for Manufacturers.

Apply—

THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

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FOR Sale, 15 pairs Rolled-Steel Moulding Boxes, 30 in. x 18 in. x 3 in., each part 24 loose pins.—Box 110, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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